THE

INTELLECTUAL OBSERVER

REVIEW OF NATURAL HISTORY

MICROSCOPIC RESEARCH

AND

RECREATIVE SCIENCE

VOLUME VII

ILLUSTRATED WITH PLATES IN COLOURS AND TINTS, AND NUMEROUS ENGRAVINGS ON WOOD

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THE INTELLECTUAL OBSERVER.

FEBRUARY, 1865.

NOTICE TO OUR READERS.

It is now three years since the issue of the first number of the Intellectual Observer, and we may congratulate our readers and ourselves on the success of an experiment that would not have been attempted in any other country, and that would not have been justified by the state of education in England ten years ago. There is no characteristic of the present condition of our society more satisfactory than the rapid, but at the same time steady, growth of a taste for physical and descriptive science. Especially in the direction of natural history (including geology) has this development been manifested; and next in order of popularity, observational astronomy has secured its votaries in hundreds of English homes. For one microscope or telescope that was pointed by the last generation at the minute wonders of earth, or the gigantic marvels of heaven, hundreds are now in daily or nightly work.

During the last three years we have ministered to these pursuits, and we have reason to know that our exertions have been the means of largely extending the number of their followers, and thus creating a still further demand for such information and help as our columns can afford. We have endeavoured to provide for those wants which have been most strongly felt by the growing class of Intellectual Observers but while devoting a large portion of our space to natural history, microscopy, and observational astronomy, we have not omitted to present a many-sided view of the progress of science in all the variety of its departments; so that the six volumes we have issued will be found to contain an exposition of the most striking facts and the most important principles that have been discovered or elucidated since our labours began. Amongst the special subjects of this period which have been discussed in our pages, we may mention the new and important applications of the spectroscope, an instrument of physical analysis, which has not only added to our list of terrestrial substances, as in the discovery of thallium and rubidium, but in

the hands of our distinguished contributor, Mr. Huggins, has given us the most wonderful intelligence concerning the composition of nebulæ and stars. The newest philosophy of geology, the latest application of the mechanical theory of heat, the most interesting researches of the physiologist and the comparative anatomist, the cardinal facts exhibited in recent chemical, electrical, and meteorological investigations, have been placed before our readers without delay. We have likewise published numerous important papers on subjects pertaining to archæology and ancient and modern art.

Having thus briefly reviewed the past, let us consider what, so far as we can see at present, the future demands. During the three years that have elapsed, a large correspondence and many careful inquiries have acquainted us with the fact, that our subscribers desired a selection and treatment of subjects, continually pressing us onward in the direction of expense; we have, indeed, been continually urged to do what could not be expected of any other publication by reason of its cost. The proprietors and the editor gratefully acknowledge that the Intellectual Observer has attained a position, both in this country and beyond its borders, that will justify any outlay necessary for the further development of its plans; but when, as they believe in conformity with the wishes of their supporters, they have made arrangements of a very costly kind for the purpose of increasing the interest and permanent value of this magazine, they feel assured that their subscribers will willingly contribute a small addition of six shillings a-year. The future price of the Intellectual Observer will be Eighteenpence for each part, and it will be so managed as to maintain its character of being the cheapest publication of the kind that has ever been produced.

The plan upon which the Intellectual Observer has been and will be conducted, renders it peculiarly advisable that subscribers should possess complete sets. The publishers will as far as possible endeavour to meet probable demands for back numbers; but some are already nearly exhausted, and others are rapidly following in the same track. They cannot offer to reprint former volumes or single numbers, as the sale of a few hundred copies to complete odd sets would be very far from covering the cost of reproducing the elaborate plates. They would therefore respectfully urge all subscribers to send an early application for any back numbers or volumes, and in future not to reckon upon being able to make up their sets *at any time*, as no more copies will be printed than the publishers have reason to believe will be sold within a moderate period from the date of publication.

The Intellectual Observer will continue to provide

materials adapted to readers in various stages of scientific progress. A portion of each number will be devoted to beginners in various scientific pursuits, and when any reader meets with an article beyond the existing state of his knowledge, he will either find that an elementary paper leading up to it has already been published, or he may expect that one will follow at no distant date. In the selection of topics regard will be had to their novelty, and to their quality as subjects of the day: thus an INTELLECTUAL OBSERVER student will be always up to date; and side by side with matter for novices just entering the portals of knowledge, will be found subjects for the consideration of those who have penetrated the inmost recesses which the human mind has reached.

An additional department has been created for the purpose of affording the earliest explanations of new inventions and discoveries in the applied sciences, and in the practical arts. The information will be conveyed in simple untechnical language, and the record will embrace the principal achievements of human skill in Great Britain, on the Continent of Europe, and in the United States.

In conclusion, we would earnestly advise those who find their first steps in science difficult, not to confine their endeavours to mere reading. Do something, try something, or see something, and half the hardship disappears. It is astonishing how many difficulties in natural history or physiology may be made to vanish if a student will work with a microscope as directed in any of the numerous practical papers we have published. In like manner, a few evenings spent with a telescope under Mr. Webb's instructions, will render many explanatory statements easily intelligible, when without such a proceeding they would remain obscure; a glance through a spectroscope will make a beginner take ten-fold interest in Mr. Huggins' discoveries; and a few chemical experiments will simplify many a statement or illustration that without such aid could convey little to the mind.

Parents may depend upon it that good books and good apparatus are amongst the most remunerative investments they can make. Homes to be happy must be enlightened, and where Intellectual Observers most abound, the wise and beneficent lessons of nature will be most reverently received, and man will form the noblest conceptions of the duty and destiny of a being, situated on a narrow spot of a little revolving globe, limited in faculties, brief in life, and yet divinely endowed with a capacity for evolving thoughts and aspirations grander than all the material powers which condense nebulæ into suns and systems, and which unceasingly arrange and rearrange the particles that build up the fabric of unnumbered worlds.

THE NILE AS A SANATORIUM.

BY F. W. FAIRHOLT, F.S.A.

(*With a Coloured Plate.*)

Facilities in travel, more wonderful than the dreams of ancient poets, await the modern voyager; annihilating difficulties of time and circumstance, smoothing his path in the wildest regions, making his journey a mere question of time and money. Nowhere can these facts be more forcibly felt than when travelling on the railway between Alexandria and Cairo. Seated in comfortable carriages of English construction, it is not difficult to imagine oneself on a dusty road, in a hot day, going through Lincolnshire; but a glance through the windows over the flat land of the Delta, shows that we are flying through a primitive land where the very existence of a railway seems an anomaly. Fields of cotton and maize, groups of palms, clusters of mud hovels, some gaily painted, tell of a strange country. Groups of natives in dresses with which we have only been familiar in pictures or on the stage, occupy the road, which runs close by the railway the whole distance. Long lines of lazy-paced camels, or active herds of sharp and useful asses, mix with the rest, giving life and variety to a scene without one European feature in it.

This ease of transit and the constant recommendation of the climate of the Nile by eminent English medical practitioners, as a means of soothing, allaying, or even curing disease, has induced so great an accession of travellers that the country has been much enriched thereby, and places that a quarter of a century since were rigidly barred to the stranger, now gladly open their portals at the bidding of infidel gold. When it is remembered that more than two hundred boats usually ascend the river from Cairo every winter, returning there after three or four months' transit; that these boats are native boats hired at an extravagant rate, chiefly victualled by natives, and include a crew of from fourteen to sixteen men, and that all things are charged to Europeans at nearly double what natives would pay, it may be readily understood that whatever hate to the infidel may warm the heart of the Egyptian true believer, the greed of gain will induce him to keep a placid, smiling countenance.

Still, health when lost is cheaply re-bought at any price. It is the object of this paper to consider this question of the Nile as a watering-place for invalids, and to put before the would-be traveller in search of health a simple statement of facts, that he may be in a fair position to judge for himself if

he be able to bear all the disadvantages, which inevitably accompany the advantages, that present themselves. It must be borne in mind that home medical men are not always the best fitted to decide on an invalid's place of residence abroad. Most doctors are confined to the narrowed sphere of a busy practice, and have generally very shallow and circumscribed ideas of foreign climates, founded on vague reports, or descriptions by enthusiastic travellers, from which no sound conclusions can be drawn. The author of this paper has passed two winters on the Nile, a confirmed invalid, suffering from bronchitis and asthma, and therefore believes himself more competent to speak than any untravelled doctor of London or elsewhere.

But before describing river life on the Nile, it will be well to detail the best mode of getting there. For those who carry much luggage, and object to changes on the route, the simplest and best way is to embark at Southampton, when they will disembark at Alexandria. This, however, involves a long sea voyage across the Bay of Biscay, at a time when storms are usual, and sometimes bad weather from Gibraltar to Malta; the journey occupying altogether about eleven days, the entire voyage being fifteen. Or only a week's sea voyage need be made, going by way of Marseilles to Malta. This involves three long days of railway travelling from London, and all the chances of hotel accommodation, troubles with luggage, etc. Having tried both ways, and being "a good sailor," unaffected by the worst weather, the author comes to the conclusion that nothing can compensate the miseries of a long sea voyage, which is in itself enough to destroy an invalid.

From the beginning of December until the end of March is the only time for the stranger to safely visit Egypt. Before that time he may subject himself to heats which may produce dysentery and ophthalmia; after it he may be met by the *Khamseen* desert wind, which undermines the system, producing lassitude, fever, and death. Consequently the time of year when the voyage must be taken is little likely to ensure a quiet sea.

Arrived in the Bay of Alexandria, transit-boats are provided for passengers who wish to go direct to the railway-station, about a mile distant. Six hours' railway travel, and Cairo is reached; at its port of Boulak native boats are stationed for hire; they are expressly built for the river voyage, drawing not more than two feet of water, as the river in winter is very broad and shallow, and boats are often grounded on the sandy shoals. The native name for these boats is *Dahabeah;* they closely resemble the barges once used by our city companies on the Thames. The saloon is level with the deck; behind it are the

cabins; its roof is covered by an awning, and furnished with sofas, so that the day may be passed agreeably there. When the weather is calm, sailors row; when a breeze arises, the large sail is spread, and the heavy vessel speeds rapidly on. Its form is shown in the engraving, contrasted by the ordinary native boat beside it.

Once afloat, life on the river becomes very monotonous. Cairo is so full of bustle and picturesque beauty that the loneliness of the river a few miles from it is doubly drear. Enthusiasm, and the novelty of the position, has its usual effect for a time; but this wears itself out after days of drifting between high banks of mud, relieved only by clumps of palm trees, squalid villages of earthen huts, and glaring lines of limestone rock. Until Minieh is reached the river is dull and featureless to an extreme degree, and becomes almost insupportably tedious on the return voyage.

About four miles further, and we reach the ruined and half-deserted village of Beni-Hassan. Here are the famous rock-cut sepulchres, covered internally by wall-paintings, made by the ancient Egyptians three thousand years ago. They furnish us with the most vivid delineations of the manners and customs of this people we possess, and are the mine from which our modern books, at home and abroad, have been furnished with their most interesting illustrations. They are now all miserably injured where within reach. Time has spared them, and even native barbarity, that looks unfavourably on such art, has held the hand here; the mischief has been chiefly done by recent European travellers, who delight in writing or scribbling their obscure names on the walls, or breaking away fragments to take home. When we remember that these old works have afforded us our best comments on the truths of Bible history; explaining its allusions and proving its genuine character, as a minute record of past manners; it is sufficient to raise honest indignation at finding Christians thus behaving worse than Turks, particularly when we remember that the Nile journey is an expensive one, and cannot be undertaken by any but those whose education and position should ensure better behaviour.

From Minieh to Siout, the capital of Upper Egypt, the river presents much variety of scene; the rocky chain that bounds the valley of the Nile sometimes closes on the stream in picturesque cliffs, and at other times opens on verdant plains, brilliantly green with abundant vegetation. Siout is charmingly situated; but the traveller may sometimes be long delayed in reaching it, as the river curves continually, and winds are often adverse. He must be prepared to be anchored in a sheltered place occasionally for days together, and bear *ennui* as best he may.

Girgeh is the next town of importance, and here the changes the river has made in its bed are curiously apparent. When Pococke visited it, in the early part of the last century, it was a quarter of a mile from the stream that now yearly washes a portion of the town away. Long lines of buildings, sapped at their muddy foundations, hang ominously over the banks, to fall at the next inundation.

Crocodiles may now be occasionally seen, lying in the sun on sand-banks or low rocks, looking like great slugs, and apparently unconscious of travellers. It is, however, extremely difficult to get near one of them. They crawl lazily into the water as the party approaches within gun-shot distance; to kill them is very difficult, as they have few vulnerable points; if they be wounded, they sink into the river, and go very far away to die. As Nile travelling has increased, so has their caution; they were never bold, except at a sudden advantage.

From Girgeh to Keneh, a distance of sixty-four miles, the river again assumes a tedious monotony. Keneh is a lively town, pleasantly placed amid verdant fields. It is the great gathering-place for pilgrimages to Mecca. Opposite, at a distance of some five miles, stands the half-buried temple of Dendera. The road to it is over rough ground, sometimes partly tangled by coarse desert grass. It is the first important building of ancient date that courts the traveller's attention after the Pyramids are passed. Nothing more perfect exists on the banks of the Nile, or will better reward a visit.

A grand chain of mountains, with outlines of a more picturesque character than usual, bounds the cultivated land on the African side of the river. It is generally about one day's journey from Keneh to Negadeh. This latter place is remarkable as one of the earliest towns where Christians congregated in any number, and where they still live unmolested. A large monastery stands in a garden adjoining the river. About ten years ago it was calculated that this town contained about 3000 Christians, and not more than 500 Mahommedans. A brisk trade is carried on in the manufacture of the coloured cotton wrappers, used like the Scottish plaid by the native inhabitants. The town has the look of a strongly fortified place, from the abundance of tall towers that encircle it; these are, however, very peaceful erections for the breeding of vast flocks of pigeons, bringing an income to its inhabitants. The place altogether is a good specimen of an Egyptian town; it is enclosed by earthen walls, and shut in at night by heavy wooden doors; these open upon narrow lanes, from which others diverge; the whole interior being a labyrinth of gloomy dusty passages, where all kinds of refuse festers in the heat, uncared about. The Orientals are incapable of comprehending

foul smells, and the traveller will find it sometimes necessary to anchor his boat on the windy outskirts of a village or town.

With a fair wind, another day will bring the traveller to Thebes. He will probably be disappointed with the aspect of the world-renowned spot. The Libyan hills are grand features on one side of the stream; but a vast plain stretches towards the Red Sea on the other. The high mud banks on both sides, and the low water in the river, prevents any extended view, hence a sense of flatness or tameness pervades the scene. Luxor, the general landing-place, where all boats anchor, relieves the monotony; it is on high ground, crowned by the ruins of a fine temple. All here is bustle and activity. The bank is lined with travellers' boats, acquaintanceships are renewed, pleasant parties formed for visiting the objects of interest that crowd upon attention here. The natives are busy to obtain employment as guides or attendants, or as salesmen for antiquities of all kinds. Time speeds rapidly away, and a fortnight can never be passed more agreeably than here. The temples of Luxor, Karnac, Gournou, and Medinet-abou; the Colossi on the plains, the wild mountain passes leading to the Tombs of the Kings, all combine to astound the visitor, and give him pleasant memories to dream over in after life. No descriptions and no pictures can convey a complete idea of the wonders of the Theban plain; and when, after days of pleasurable fatigue, the traveller welcomes the repose of evening, it is ushered by sunsets of gorgeous magnificence, the golden light of the sun gives a tinge of green and purple to the blue sky near it, flaky clouds of fantastic form gather around, bearing tints of brightest rose-colour, those nearest the setting sun luminous as himself, so that the eye can scarcely dwell upon these flecks of burnished gold. When the sun has set, an after-glow of rosy light gleams over the entire land for some minutes, with enchanting effect; and the stranger feels, upon his last day on the Nile, that he may never chance to see the sun set again in such supreme glory elsewhere.

With the large majority of travellers the Nile journey ends at Thebes; it is 454 miles distant from Cairo, and the voyage occupies from three weeks to a month, according to wind and weather. Travellers should allow themselves two months and a half for the whole journey and the unavoidable stoppages. It is a slow business at the best of times, nor can Oriental indolence be stimulated.

Should the traveller persevere to the boundaries of Old Egypt at the first cataract, he will be well rewarded by the greater beauty of the river, the vast and wondrously-perfect temple at Edfou, the rock temples and quarries at Silsilis, from whence the ancient Egyptians obtained their building

stones; the grand ruins at Kom-Ombos, and the picturesque town of Assouan. Here he may safely anchor his boat, and ride to the cataract, seeing something of Nubian village-life at Mahatta, where live the men who navigate the boats through the wild and dangerous current of the rock-encumbered river. They are most extortionate in their charges for such service, and demand from £20 to £40 per boat, according to its size; and as they alone have the monopoly of the stream, and are the only persons competent to manage the boats, the traveller is at their mercy.

The Island of Philæ, beyond the cataract, can also be easily visited by a ride across the desert. Its beauty has been celebrated from the earliest recorded time, and has been enthusiastically dwelt on by modern travellers. It is surrounded by rocky scenery of a wild and wondrous kind, as if some gigantic convulsion had piled these vast heaps of granite and basalt, and choked the river.

Fewer still are the voyagers who persevere to Wady Halfeh, that they may visit the rock-cut temple of Abou-Simboul. It is a long and dreary voyage of 837 miles from Philæ, with nothing on the way to equal what the traveller has already seen. The temple is, however, unique in its kind, and very wonderful; the journey must, therefore, be a question of time and expense for each individual to solve before starting.

The price charged per month for the hire of a boat varies according to its size and character, and ranges from £50 to £70. The sailors' wages are low, and are generally computed by the month also; the reis, or captain, receiving about 30*s.*, the sailors half that sum. But these very cheap rates do not truly represent all the traveller pays by a very great deal, inasmuch as gratuities are expected when the boat reaches the larger towns in its course; and the ordinary food of the crew has also to be paid for. A sheep is the usual gift expected, as bread and dried lentils are all the stores laid in for the sailors. A dragoman, or interpreter, is also necessary for the voyage; he generally commands a high salary—about £12 a month, and he takes "black mail" with no niggard hand during the entire journey, first from the natives, and secondly from his employers, so that frequently one-half of the money paid for travelling expenses finds its way into his pocket. It is also necessary to carry a cook and a native servant or two, as assistants or waiters, who generally speak a little English, and charge accordingly.

Should the traveller be an invalid, it is beyond all things necessary for him to remember that he can obtain no medical aid after he leaves Cairo; many English travellers, particularly if they be wealthy, carry a doctor with them, and, to the

honour of the profession be it spoken, that abroad as at home, they never tire in giving their best aid cheerfully to all claimants. Native doctors, if met with in a few of the larger towns, are generally some degrees below the Italian mountebanks who draw teeth and dispense medicines at a country fair. The people, with their inherent fatalism, prefer charms to physic, and have most faith in them.

It must also be borne in mind that though England be stigmatized as a variable climate, the climate of Egypt is more constantly changing. We get at home great changes of wind from different points of the compass; but they usually last for days together, and the difference in temperature throughout the day, or at night, is not very violent. But on the Nile the temperature shifts with every few hours, increasing to mid-day, decreasing to evening, and being freezingly cold in the night; so that the constitution of an European is severely tried when the thermometer may be at 60° at ten in the morning, 100° at noon, and down to 40° in the night. It brings forcibly to mind the words of the patriarch Jacob, when he complained—"By day the drought consumed me, and the frost by night." There is no provision whatever for obtaining fires in the boats, and doors and windows are so constantly warped by the sun that they let in cold draughts on all sides, which can only be guarded against by good coverings. The traveller must in truth be prepared for hot summer days and cold winter nights, and will often find it necessary in the day to change his attire as heat or cold predominates. It is therefore evident that for an invalid to trust implicitly to glowing accounts of Egyptian days, not taking the dark side of the picture in the aspect of Egyptian nights, would be condemning himself to a great risk. Healthy travellers, writing enthusiastically of their experiences, are very blind guides; and doctors who have no travelled experiences whatever are blinder. To some invalids it would be little short of a condemnation to death to send them up the river in draughty boats, without chance of medical aid. The invalid should be well prepared for this; take his own medicine chest, if he cannot take his own doctor, never come on deck before eleven o'clock a.m., or be seen there after sunset, and closely curtain his cabin-windows before going to rest.

The conclusion that the author of this paper arrives at is simply this—that advantage should be taken of the Egyptian day, and the night guarded against. Therefore he is of opinion that a residence in Cairo is preferable to a boat life on the Nile. Cairo has good hotels and resident medical men; full advantage may be taken of the bland climate by day, and comfort be had at night in hotels kept by Europeans. There

is constant amusement in the busy life of the city, while for such as have tastes for historic antiquities, the neighbourhood abounds in sites and objects of the highest interest. If desert winds blow, or the climate generally be too relaxing, the railway will in six hours carry the traveller back to Alexandria, where the cooler sea breezes give the climate the character of Greece or Southern Italy.

Such, then, is a fair estimate of Nile travel. To the invalid it is not the same as to the healthy; the latter will experience no inconvenience where the former may find much. The glorious old river and the solemn reliques of the great men of old that line its banks, deserve all the enthusiastic greetings of the students of antiquity, art, and history. Happy are the days when, floating in the sunshine on its placid bosom, place after place is reached, abounding in wondrous memories; and the homeward-bound traveller bids adieu to the sacred stream, conscious that while life lasts he may call back unrivalled remembrances of scenes, upon which Moses and the father of history have also gazed, with greater wonder, when all that is now ruined was in the glory of its pristine magnificence, under the rule of the ancient Pharaohs, in ages which have long since passed away.

VEGETABLE HYBRIDS AND THEIR PROGENY.

M. Ch. Naudin has recently communicated to the French Academy the results of fresh experiments on vegetable hybrids and their descendants. He states that in 1862 he made numerous crosses, all successful, between *Datura lævis, ferox, Stramonium,* and *quercifolia,* four well characterized species, between which no intermediaries were known. *Datura lævis* and *ferox,* the two species which differ most in the white series, being mutually fecundated, he reared in 1860 from seeds obtained through this double crossing, sixty specimens of *Datura lævi-ferox,* and seventy of *D. feroci-lævis.* "In this first generation, the whole collection of hybrid individuals having the same origin, however numerous they might be, was as homogeneous and as uniform as could be in a group of any invariable species, or of a pure and sharply characterized race."

"But these 130 hybrids presented a novel fact: they were not only perfectly like each other, but they differed strangely from the two species to which they owed their origin. There was neither the form, the aspect, nor the fruits of the parent species, nor was there anything intermediate between them.

Any one ignorant of their origin must have taken them for a new species." They were all of the violet series, with brown stems, while the parent species had white flowers and green stems.

In 1864, M. Naudin made a fresh sowing of *D. lævi-ferox,* and *feroci-lævis,* and by side of them *D. ferox* and *D. lævis* of pure race. The result was, that thirty-six new specimens of *D. lævis-ferox,* and thirty-nine of *D. feroci-lævis* reproduced the identical characters of the former year, brown stalks, violet flowers, and spinous fruits. He noticed that at the commencement of germination the little stem of *D. ferox* of pure race was purple, so that this colour seen in the hybrid stems was apparently derived from that species. "All these hybrids, though sterile in the first six or seven dichotomies, were fertile in those following. Their seed sown last spring, gave, in the second generation, nineteen specimens of *D. feroci-lævis,* and twenty-six of *lævi-ferox.* The two lots still resembled each other, but by a character the very opposite of that which was most salient in the preceding generation. The great uniformity then remarkable was succeeded by a surprising diversity of patterns; so that out of forty-five plants, composing the two lots, no two could be found that were exactly alike." They differed in all particulars. One lot, however, of *lævi-ferox* went back to the type of *D. lævis,* except that the lower part of the stem was purple. In very few was a slight resemblance to *D. ferox* noticeable, most being more like *D. Stramonium* and *D. quercifolium.* "Some had white flowers and green stems, either all green, or with purple at the base; others had violet flowers of different tones, and stems more or less brown; sometimes even purple, passing into black, as in *D. tatula,* which is the most perfect type of the violet series. The fruits were of all sizes, from a filbert to a large nut; and of these fruits some were very spinous, others only covered with tubercles, or nearly destitute of spines. Some individuals fructified in the first dichotomy, others only in the last, and some produced no fruit at all. In fine, the forty-four plants, constituting these two lots, were all individual varieties, as if the tie binding them to specific types were broken, and their growth had run wild in all directions."

M. Naudin then mentions a case of hybrid Marvel of Peru, in which the second generation differed both from the parents and from the first.

In 1863 and 1864, he watched the sixth and seventh generation of a hybrid *Linaria purpureo-vulgaris* which he had kept for many years. A good many went back, some completely, some partially, to the *L. vulgaris,* with yellow flowers, and a smaller number to *L. purpurea,* with purple flowers. The

major part inclined to neither species, nor did any resemble the first hybrid generation, but presented all kinds of variation.

M. Naudin then refers to hybrid petunias, which, he says, though common in gardens, have not received the attention due to them from scientific men. He says that *P. nyctaginiflora*, which has white flowers, and *P. violacea*, with violet, cross with facility, producing hybrids as fertile as themselves. In the first generation all the hybrids resemble each other; but in the second they became diversified in a surprising manner, some becoming white, some purple; while others, and they constitute a large residue, exhibit all tints between the two. If a third generation is raised by artificially fecundating the second, still greater variations occur, and if the process is continued monstrosities are obtained, which fashion decides to be perfection.

Similar facts occur with primulas, roses, apple-trees, pears, etc. The question then arises, "but if these crossings have produced such phenomena of irregular variability in cultivated plants, is it not possible that the same cause has occasioned their appearance amongst wild plants? We are led to think so when we cast our eyes on certain generic groups, such as sallows, potentillas, briars, etc., in which those species which at first seem the best characterized, are united by so many intermediate forms, that we do not know where to place the limits of such species. This supposition is the more probable, because the species in question are so situated as to render their crossing likely to occur." M. Naudin then makes certain observations on the variations which different species exhibit without any crossing with another species or race. He considers that with hybrids the tendency is towards individual variation without fixity, while with pure races variations tend to become constant, and if not interfered with, give rise to fresh races homogeneous and enduring.

Many of our subscribers will have opportunities of making experiments similar to those of M. Naudin, and they may be reminded that both naturalists and physiologists anxiously look for additions to this class of facts.

THE AUSTRALIAN LYRE BIRD.

BY "AN OLD BUSHMAN."

THE Lyre Bird, or native pheasant of Australia, *Menura superba* of naturalists, called Bulla bulla by the natives, from the peculiar monotonous call-note of the female, is, as far as body plumage goes, a very plain, dull-coloured bird, about the size of the common English pheasant; but its singular beauty consists in a long, beautiful, lyre-shaped tail of sixteen feathers, with the peculiar form of which most of your readers are, doubtless, acquainted. According to Mr. Gould, the stronghold of the lyre bird is in the colony of New South Wales; but to my certain knowledge it is, or at least was, a few years since, common in most of the ranges and gullies extending eastwards from the Bass River to the Tarra in Gipps' Land, and also in the gullies on the Plenty, Dandenong, and Gipps' Land ranges. It is from the personal observations of myself and a friend, now stationed in this district for the purpose of collecting, that the following notes are compiled:—

Of the numbers of those who at one time or another must have seen and admired its fibrous and lyre-shaped tail, but few were perhaps aware of the fact that the light and fairy-like structure before them was the elegant appendage of a bird whose powers as a ventriloquist and imitator of sounds appear to be illimitable. To be able to form a fair estimate, however, of their extraordinary abilities in this respect, one must be on the pheasant ground by earliest dawn on any fine morning during the months of June, July, and August, this being their breeding season, during which they are most noisy. Now this is not quite so easy as might at first appear, since what the bushmen call their "whistling heaps"—little circular mounds of scratched-up earth in the centre of a mass of ferns, or sword grass—are generally located in the thickest part of a dense musk scrub, or by the sides or at the bottom of a deep fern-tree gully, whose cloistral shades, like true recluses, they greatly affect. To pierce such solitudes as these before the sun has risen, struggling up to the waist through a thick undergrowth of grass and fern, saturated with everlasting dew, at the imminent risk of breaking either neck or shins in stumbling over some of the numberless fallen logs that intercept your path, and where every step you take necessarily brings you into collision with an overhanging bough which discharges a copious shower-bath over your head and shoulders, is, to say the least of it, not pleasant, and not likely often to be attempted by any one, save those actually in pursuit of the bird itself.

A previous night's camp near the spot would, in most cases, bring a man into the vicinity of the birds sufficiently early for his purpose of watching them at play. The first intimation of this would probably be a rather loud, though melodious warble, from some old cock on a neighbouring tree, for he generally salutes the rising sun from his roosting place. With its earliest ray, however, he descends from his perch, and you will then hear the monotonous "bulla bulla" of the hen bird as she calls to her mate, and together they go scratching about the bush for their breakfast. Soon an old cock will scratch his way to one of these mounds, which are, doubtless, feeding places as well as arenas for their morning concerts, and then, with a running fire of his own sweet notes, which he keeps up throughout the whole performance, the fun begins. Now, if you are clever enough to creep within good earshot of that little magic circle without disturbing the bird, you will find that from thence proceed in rotation the note of nearly every bird indigenous to the scrubs. First, perhaps, you will hear, not one, but a whole mob of King parrots, or lories, in full corroboree, the noise of their wings in flight being at the same moment imitated with the greatest exactness; then probably comes the smack of the whip bird, then the harsh cry of the black cockatoo, together with the grating sound he makes with his bill in excoriating the bark of the tree in search after grubs. All this, together with many another cry of bird or beast, even to the howling of the wild dog, I have heard proceed from one and the same lyre bird in a very short space of time. Should there be wood cutting, or any other extraneous noise going on in his neighbourhood, he quickly makes himself master of the sound, and adds it to his budget. I have frequently heard the beating of the blacks' corroboree sticks imitated to perfection. This the blacks themselves maintain is done with the tail of the bird. During the greater part of the time that the bird is thus engaged the tail is spread out, peacock fashion, at right angles, but sometimes laid so low as to form a very acute angle with his back, the bird himself slowly revolving on his little orbit, and every now and then regarding his fairy appendage with looks of gratified vanity. It is only while thus occupied that he can be approached with any chance of success. In such situations, however, he falls an easy prey to the noiseless and panther-like approach of the blackfellow; but the attempt of the white man is generally foiled, either by the brightness of his apparel or his over anxiety to reach his quarry, which induces him to move when the bird is not in full song—a fatal error, quickly made known to him by a serpent-like hiss, which tells in a language plainer than words that his presence is detected. It must not,

however, be inferred from the above that the cock bird is the sole performer; the hen will also both whistle and mock the notes of other birds, but she does it in a more desultory manner, never remaining long in one spot.

These birds sometimes vary their entertainment with the most amusing capers. A friend of mine once having followed a pheasant to its roosting place, which in this instance was a tall gum tree in a tolerably open situation, determined to be near the spot by daybreak, in order to watch his manœuvres, and, if possible, obtain the bird. Accordingly, before break of day, he posted himself near the tree, and soon after had the satisfaction of seeing the bird descend from it, and at once commence scratching and feeding on the ground below it. This bird was evidently in a merry humour, for nearly every log he came across he mounted, made three or four pirouttes on the top of it, and then on again, until he came to a full stop, when, after mocking the whip bird, the laughing jackass, and one or two others, he suddenly began revolving in a circle, the diameter of which was scarcely greater than the length of his own body, at such an amazing rate that it was impossible to see his feet touch the ground. A charge of No. 4 shot, however, cut him short in the middle of his gyrations, and he proved to be a cock with what the bushmen call a half tail, *i.e.*, half plain, half fibrous. The tail feathers, at first wholly plain, always commence shredding out backwards from their extremities to their springing, till they become wholly fibrous. I have heard that in the case of very old birds the tail sprouts fibrous like the pheasant wren, but I never met with an instance of this myself. The Gipps' Land blacks believe that the hens after a certain period get fibrous tails like the old cocks, but if this is true, it must be after they have done breeding. The dome-shaped nest and chocolate-coloured egg (they lay but one) is generally placed either in the embankment of a deep creek or gully, or else well hidden in the midst of the branches, where they spring from the stem of one of a group of fern trees. Where these trees grow thick, and their branches interlace, their resemblance to a mediæval crypt or cloister is most striking, save, perhaps, that the cone-fretted stem of the fern tree has rather a Moorish than a Christian look about it; and the thought has often struck me while wandering under the melancholy boughs of these splendid Filices, how astonished the Old World builders would have been could they have been told that in the recesses of a country to them unknown, there grew in wild luxuriance the living counterpart of their own stone and mortar erections. I will just mention one fact with regard to the nest which shows the extreme cunning of these birds, viz., that it is almost always covered with a coating of

living moss, which literally grows over it, and so amalgamates it with surrounding objects, that were it not for the suspicious little hole at the top it would be impossible to discover it.

Before concluding these remarks, I feel bound to bear testimony to a pleasing trait in the economy of these birds, which is the remarkable solicitude of the female for her young one. Although at all other seasons she is, *par excellence*, the bird in which the *noli me tangere* principle is most strictly developed, yet during the period that her offspring is a helpless nestling, she so far overcomes her natural timidity in anxiety for its safety, that if you touch the young bird, causing it to make a plaintive cry, and the mother is within hearing (which is generally the case), she will come through the bush like a flash of light, and, seeing the formidable appearance of the disturber of her home, will commence rushing about in gradually contracting circles, evidently in the greatest distress. In marked contrast to this, however, is the conduct of the male bird, who, after the period of incubation is over, never goes near the nest, or appears to care a pin what becomes of his family.

As civilization gradually increases, many birds and animals are becoming so scarce or altogether extinct, that in a very few generations after this they will be known only by name, or as matters of history. Witness the kangaroo, the emu, and even the native pheasant, and some others in this very land. It is, therefore, a matter of considerable surprise to me that no systematic efforts are made to rear and domesticate many a bird and animal which is every year becoming scarcer, and which would doubtless thrive under the fostering care of man. I have known this tried in regard to the very bird of which we are now treating; but the few schoolboy attempts which I have witnessed never can and never will succeed. A friend of mine, who has now studied the habits of the lyre bird in a state of nature for many years, and who in one season obtained in Gipps' Land no fewer than 114 tails with his own gun, has written to me a plan by which he feels confident that he could rear them, and I think his system a likely one, but it would entail great expense and loss of time; and to the poor bushman, whose time is money, and whose sole dependence for subsistence is his gun, the advantages of success in undertakings of this nature are not at all commensurate with the certain loss in case of failure. "Should this noble bird, however"—thus he concludes his letter to me—"be domesticated, and I feel certain that this day will come, and he should retain in captivity those admirable powers of mimicry which he daily exhibits in the recesses of his native forests, universal consent would, I have no doubt, acknowledge his right to the title of the 'King of Mocking Birds.'"

THE BRITISH OCEANIC ENTOMOSTRACA.

BY GEORGE S. BRADY, M.R.C.S.,

Secretary to the Tyneside Naturalists' Field Club.

(*With a Coloured Plate.*)

UNDER the term "Oceanic Entomostraca" we include all those free-swimming species which are met with not far from the surface of the sea, either in littoral situations or in the open sea far away from land. We do *not* here take cognizance of those which haunt the sea bed and find their sustenance by crawling over weeds and rocks, their powers of swimming being either altogether wanting, or so slight as to serve only for very short excursions from the ground.

The species to which our present paper refers are met with during the warm months of summer in wonderful abundance near the surface; so numerous, indeed, are they that they constitute the chief food of very many fishes, and they may often be plainly seen to impart a turbid or specky appearance to the water. They are best taken by means of the towing-net, an appliance which, for the benefit of those who are not acquainted with it, we may briefly describe. It consists of a long funnel-shaped net of bunting, crinoline, or some other strong but loose-meshed material, attached to a ring of cane, eighteen inches or more in diameter. It is well to weight the ring moderately at one side, so as to sink it a little beneath the surface of the water. But besides the outer net above described, there should be an inner net made of the same material, of the same diameter, but only of half the length, and tapering more rapidly. This is to be left open, with an aperture of about a couple of inches at its narrow end, and is intended to act as a valve to prevent the regurgitation of the contents of the outer net when being dragged through the water. The apparatus will be more convenient if the outer net, instead of being sewed up close at the small end, be left with an open neck, to which a cupping glass or a strong glass bottle may be attached by a piece of string or elastic. The bottle thus attached will receive the contents of the net, which may be removed much more readily and with less injury than by turning a net inside out, which must be done if not provided with this arrangement. Three or four strings are to be attached at equal distances round the ring of the net, tied together at their free ends, and finally secured to a long and strong cord, by which the net is


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dragged through the water at the stern of a boat. It will often be found to collect (besides the small crustacea) great quantities of medusæ, free-swimming annelids, and larvæ of many kinds. These (except the medusæ, for which no good preservative fluid is yet known) may be put into spirit, and thus kept for examination.

Setting aside any special interest which these entomostraca may possess for those who give particular attention to them, there are some points in their structure and physiology which are exceedingly curious, and which cannot fail to interest any "intellectual observer." These are connected chiefly with sexual differences. In the family *Harpactidæ* the males possess, for the most part, a large vesicular swelling on the upper antenna (see Fig. 1); while in the female the antenna is more slender, and destitute of this appendage. In the *Pontellidæ* and many of the *Calanidæ* the right antenna of the male is provided with a hinge-joint near the middle, for the purpose of clasping; and above and below the hinge there is a serrated plate which serves to render the grasp more secure. The left antenna of the male, and both those of the female, are destitute of the hinge. In the *Pontellidæ* there is likewise a large pyriform swelling near the middle of the male antenna. This, with serrated plates and hinge, is well shown in the coloured plate of *Anomalocera Patersonii.* In the two last-mentioned families, the fifth pairs of feet offer also remarkable sexual differences, and afford excellent specific characters; these, however, are so varied, that drawings of each species would be required to elucidate them. The right fifth foot of *Ichthyophorba denticornis* is shown at Fig. 4. The curious method of impregnation which obtains amongst the Copepoda has already been mentioned in the pages of the INTELLECTUAL OBSERVER. It consists in the attachment to the abdomen of the female of elongated cells termed "spermatophores" or "spermatic tubes." These may often be seen before their emergence from the body of the male. Fig. 5 exhibits a bundle of them attached to the abdomen of the female *Temora velox.*

The oceanic species with which we are concerned in this paper, belong to two distinct orders, Cladocera and Copepoda, both of which are well represented in all our fresh-water ponds, the first by the common *Daphniæ,* the second by the still more common genus *Cyclops.*

Dr. Baird, in his excellent *Natural History of the British Entomostraca,* published by the Ray Society in 1849, describes ten marine species of these two orders:—*Evadne Nordmanni,* Lovèn; *Canthocamptus Stromii,* Baird; *C. furcatus,* Baird; *C. minuticornis,* Müller; *Harpacticus chelifer,*

Müller; *H. nobilis,* Baird; *Alteutha depressa,* Baird; *Temora Finmarchica,* Gunner; *Anomalocera Patersonii,* Templeton; *Cetochilus septentrionalis,* Goodsir. An eleventh species (*Notodelphys ascidicola,* Allman) is also provisionally included by Dr. Baird amongst the Copepoda, but this little parasite is now classed with the fish lice in the order Pæcilopoda.

More recently eight additional species have been described by Mr. Lubbock in the *Annals and Magazine of Natural History* (second series, vol. xx.) Of these, however, three are probably referable to previously published species, and one (*Monstrilla anglica*) is imperfectly known, and may very likely be found to belong to the order Pæcilopoda.

If to these we add *Peltidium purpureum,* Philippi, and *Hersilia apodiformis,* Philippi (two species first recognized as British by Mr. Spence Bate), a few others noticed by myself in Reports presented to the British Association and to the Tyneside Naturalists' Field Club, in 1863; lastly, eight species recorded for the first time in this paper, we shall have, I think, a complete list of all the known British marine species belonging to the two orders Cladocera and Copepoda.

To facilitate reference, I insert first a classified list of the British species, as far as our present knowledge extends, proceeding afterwards to notice more in detail those which are new to our fauna.

Order CLADOCERA.

Fam. POLYPHEMIDÆ.

Evadne Nordmanni, *Lovèn.*
„ polyphemoides, *Leuckart.*

Order COPEPODA.

Fam. HARPACTIDÆ.

Tachidius brevicornis, *Müller.*
Tisbe furcata, *Baird.*
Westwoodia nobilis, *Baird.*
Dactylopus Stromii, *Baird.*
„ tisboides, *Claus.*
Thalestris longimana, *Claus.*
Harpacticus chelifer, *Müller.*

Fam. PELTIDIDÆ.

Peltidium purpureum, *Philippi.*
(? Oniscidium, *Claus.*)
Hersilia apodiformis, *Philippi.*
Alteutha depressa, *Baird.*
„ bopyroides, *Claus.*
Zaus spinosus, *Claus.*
„ ovalis, *Goodsir.*

Fam. CORYCÆIDÆ.

Monstrilla anglica, *Lubbock.*
Corycæus anglicus, *Lubbock.*

Fam. CALANIDÆ.

Cetochilus septentrionalis, *Goodsir.*
Calanus anglicus, *Lubbock.*
„ Clausii, *Brady.*
Dias longiremis, *Liljeborg.*
Temora Finmarchica, *Gunner.*
„ velox, *Liljeborg.*
Ichthyophorba denticornis, *Claus.*
„ hamata, *Liljeborg.*

Fam. PONTELLIDÆ.

Anomalocera Patersonii, *Templeton.*
Pontella brevicornis, *Lubbock.*
„ Wollastoni, *Lubbock.*

Evadne Nordmanni, Lovèn. Baird, *British Entom.*, p. 114, plate xvii., fig. 2.

This species occurs in considerable numbers, in the warm months of summer and autumn, on the east coast of Britain. I have taken it plentifully off the Durham coast, and have noticed it also in gatherings from the Shetlands, given to me by the Rev. Alfred Merle Norman. Mr. Goodsir took it in the Frith of Forth. It will probably be found to exist in all the British seas.

Evadne polyphemoides, Leuckart. Leuckart, *Weigmann's Archiv.*, 1859, p. 262.

First noticed at Nice by Leuckart, and described by him in *Weigmann's Archiv.*, which description is translated into the *Annals and Magazine of Natural History* (third series, vol. v., p. 445). It is of pretty frequent occurrence off the Durham and Northumberland coasts, and also in the Shetland gatherings mentioned above. The general appearance of the order Cladocera, to which these two Daphnians belong, will be understood by a reference to the figure of *Daphnia rotunda*, given in the Intellectual Observer, vol. i., p. 448. The two species of Evadne here noticed are sufficiently distinct. *E. Nordmanni* has mostly a red tint, a large carapace, empty except when bearing ova, and tapering to a sharp point inferiorly, so as to give the animal a triangular outline. *E. polyphemoides* is smaller, has a very large spherical head separated from the body by a strongly marked neck; the carapace is very much rounded posteriorly and inferiorly, and has a straight anterior margin rounded at the antero-inferior angle. The abdomen projects anteriorly, and terminates in two strong spines directed downwards, thus giving the animal an appearance not unlike that of *Daphnia mucronata*.

Tachidius brevicornis, Liljeborg. Lilj, *Crust. ex. ord. tribus*, t. xxii., figs. 12—16; t. xxiii., figs. 1, 2, 9; t. xxvi., figs. 17, 18.

An entomostracan, referable apparently to this species, I have taken in a salt marsh on the river Wear, near Sunderland. The drawings, made with great care from my specimens, differ in at least one important particular from those of Professor Liljeborg, but from the extreme minuteness of the animal, and consequent difficulty of dissection, it is quite possible that I may have made some mistakes, and having been unable recently to find fresh specimens for further examination, I prefer rather to adopt this supposition than to describe my capture as a new species. It is probable that *T. brevicornis* may be identical with *Canthocamptus minuticornis*, Baird; but Dr. Baird's figures and descriptions are insufficient to enable us to settle that point satisfactorily. The principal diagnostic

character of the genus is found in the structure of the swimming feet, the first four pairs of which are alike, each foot consisting of two tri-articulated branches. The first antenna of the male bears a remarkably large vesiculiform swelling, a character not uncommon in this family, but nowhere better developed than in *Tachidius*. The antenna is beset also with long setæ of very diverse form and structure, the uses of which, as well as of the vesiculiform swelling, are very imperfectly, if at all, understood. The antenna is represented at Fig. 1.

Tisbe furcata, Baird. *Canthocamptus furcatus*, Baird. *Brit. Ent.*, p. 210, plate xxv., figs. 1, 2; plate xxx., figs. 4—6.

A species of very common occurrence in littoral situations, and which has been described and figured elaborately by Baird, Liljeborg, and Claus. A peculiar parasite of polypoid form is noticed both by Baird and Claus as frequently infesting this species.

Westwoodia nobilis, Baird. *Arpacticus nobilis*, Baird. *Brit. Ent.*, p. 214, plate xxviii., fig. 2, *a—e*.

I do not know this species. Berwick Bay, Dover, and the North Foreland are given as habitats by Dr. Baird.

Dactylopus Stromii, Baird. *Canthocamptus Stromii*, Baird. *Brit. Ent.*, p. 208, plate xxvii., figs. 3, 3*a*.

This pretty little creature seems to be of somewhat rare occurrence. I have taken it in rock pools on the Durham coast, and on the Isle of Man, but have seen no examples of it from other places. The localities given by Dr. Baird are all on the east coast, ranging from Berwickshire to Dover.

Dactylopus tisboides, Claus. Claus, *Die frei lebenden Copepoden*, p. 127, t. xvi., figs. 24—28.

A species which I had been accustomed to refer to *Harpacticus chelifer*, I have now little hesitation in recording as *D. tisboides*, Claus; though I am unable to state with certainty to which of the two species the figures and descriptions of Dr. Baird and Liljeborg refer. Probably they were taken indiscriminately from both species. Be this as it may, the form which I refer to *D. tisboides* is, so far as my observations extend, by far the more common of the two. I have taken it abundantly on the coasts of Northumberland and Durham, and in the Isle of Man, and it forms the bulk of one of Mr. Norman's Shetland gatherings. The characters by which it may most easily be distinguished from *Harpacticus chelifer* are (1) the form of the male antenna, which exhibits a large vesicular swelling similar to that of *Tachidius brevicornis*; (2), the first foot, which, besides minor differences, has, about the middle of the small inner branch, a long plumose bristle reaching nearly to the extremity of the ramus; and (3) the shape of the lower foot-jaw, which is a simple, somewhat oval, clawed

hand, bearing a single long bristle on the centre of its inner, slightly serrated edge.

THALESTRIS LONGIMANA, Claus. Claus, *Die frei lebenden Copepoden*, p. 130, t. xviii., figs. 1—11.

The genera *Thalestris* and *Dactylopus* are closely allied to *Canthocamptus*, from which they have been separated by Dr. Claus, in his recently published work on the Copepoda of Germany, the North Sea, and the Mediterranean. The following are the more important characters of the genus *Thalestris*. Lower foot-jaw armed with a strong prehensile hand; superior antennæ mostly with nine articulations; branches of the first pair of feet much elongated, prehensile; posterior feet of the female leaf-shaped, covering the ovisac. *T. longimana* is a fine species, richly coloured with deep brown and red. Its most remarkable feature is the largely developed chelate lower foot-jaw, which forms a very formidable and effective grasping apparatus. This is shown at Fig. 2. The first feet are very much elongated, and armed with long slender claws which, from their position, must be admirably adapted to co-operate with the antennæ and foot-jaws in the work of seizing and securing prey. The only British locality known to me for this species is Sunderland, where I have taken it in shallow tidal pools.

HARPACTICUS CHELIFER, Müller. Claus, *Copepoden*, p. 133, t. xix., figs. 12—20.

The species which I have usually considered to come under this designation is, as stated above, *Dactylopus tisboides*. The only examples I have hitherto seen of the true *H. chelifer*, are a few taken near Sunderland a year or two ago.

PELTIDIUM PURPUREUM, Philippi. White, *Pop. Hist. Brit. Crust.*, p. 308, plate xviii., fig. 4.

The family *Peltididæ*, of which this species is the type, is very different in general appearance from the *Harpactidæ*, being much broader and flatter, and less adapted for active movement in the water. They may often be met with on the fronds of Fuci and Laminariæ in tide pools, but some of them are taken by the towing net in the open sea.

Of this species, I have seen only one specimen taken in a tide pool near Sunderland. Mr. Spence Bate has taken it on the south coast of England.

HERSILIA APODIFORMIS, Philippi. White, *Pop. Hist. Brit. Crust.*, p. 308.

I know nothing of this, except from the description referred to above. It has been taken in Britain only by Mr. Spence Bate.

ALTEUTHA DEPRESSA, Baird. Baird, *Brit. Entom.*, p. 216, plate xxx., figs. 1, 2, *a*, *b*.

Whether this be referable to the following species I cannot determine, not having seen authentic specimens of it. The only habitat given by Dr. Baird is Berwick Bay, where, he says, it is not common. It is to be hoped that *A. depressa* may again be captured, in order that its relation to the following species may be definitely made out.

ALTEUTHA BOPYROIDES, Claus. Claus, *Copepoden,* p. 143, t. xxii., figs. 10—17.

This species agrees in most of its characters with *A. depressa,* as described and figured in Dr. Baird's work; but the details of structure there given are not sufficient to allow of certainty in the matter. My specimens were taken in the towing net, three or four miles off the Durham coast.

ZAUS SPINOSUS, Claus. Claus, *Copepoden,* p. 146, t. xxii., fig. 25; t. xxiii., figs. 1—10.

The genus *Zaus* is nearly allied to *Alteutha,* from which it is separated by having both (instead of only the outer) branches of the first pair of feet armed with terminal claws, and also by the greater breadth of the rudimentary fifth feet.

I have a few specimens of *Z. spinosus* taken in tide-pools at Roker near Sunderland.

ZAUS OVALIS, Goodsir. Claus, *Copepoden,* p. 146, t. xxii., fig. 18; t. xxiii. figs. 11—18.

A much larger species than the foregoing. It is very much more elongated, has comparatively short tail setæ, and a different shell structure. I am indebted to C. Spence Bate, Esq., for specimens recently taken at Banff. I am not aware that it has previously been noticed on our shores. It was originally described by Mr. Goodsir in the *Annals of Natural History* for 1845.

MONSTRILLA ANGLICA, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.,* 2nd series, vol. xx.

CORYCÆUS ANGLICUS, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.,* 2nd series, vol. xx.

The descriptions given by Mr. Lubbock (*loc. cit.*) are our only authority for the existence of these two species. They do not appear to have been found by any other observer, and the characters given by their discoverer would lead us to suppose them referable to the Pæcilopoda or fish parasites.

CETOCHILUS SEPTENTRIONALIS, Goodsir. Baird, *Brit. Entom.,* p. 235, plate xxix., figs. *a*—*g*.

Dr. Claus has divided this into two species, *C. longiremis* and *C. Helgolandicus,* and being unable to determine to which of these two forms Goodsir's description was meant to apply, has dropped the original specific name altogether. This is to be regretted, as it is almost impossible that, in the early

days of the investigation of any particular group, the minute specific characters should be understood, or, indeed (in many cases), that the really important characters should be recognized as such. Under these circumstances it seems unfair that the names proposed by the first describer should be allowed to lapse, merely because their descriptions are not found to be minute enough for the purposes of more modern science. Where two or three forms, massed together by the original discoverers under one specific designation, afterwards prove distinct enough to require separation, any author describing them would do better to fix the original name upon one of these forms, even though doubtful as to the first reference, than to ignore the labours of a previous investigator by discarding his nomenclature altogether.

C. septentrionalis, as met with in our seas, agrees entirely with the characters ascribed by Dr. Claus to his *C. Helgolandicus*. I can, therefore, entertain no doubt that Goodsir's specific name is properly referable to that form, and have here retained it on the ground of priority. The characters which distinguish it from Dr. Claus's *C. longiremis* appear in the arrangement of the long setæ of the upper antennæ (Fig. 3), and in the presence of a row of serrations on the inner side of the basal joints of the fifth pair of feet. It haunts, indifferently, both the open sea and tidal-pools, and is often to be met with in countless numbers, appearing to be pretty generally distributed in our seas. I have specimens of it from Shetland, Northumberland, and Durham, and the Channel Islands.

Calanus anglicus, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

Unknown to me, except from Mr. Lubbock's account of it.

Calanus Clausii, Brady.

A new species, described by me in a report presented to the Tyneside Naturalists' Field Club, but not yet printed. The fifth feet of the male are long and straight, slender, and composed of simple cylindrical articulations, the last of which tapers to a fine point. The first joint of the abdomen is, in the female, very tumid anteriorly. I have found *C. Clausii* abundantly in gatherings of entomostraca from Shetland, the Channel Islands, and the coast of Durham, where it abounds both in tide-pools and in the open sea.

Dias longiremis, Liljeborg. Liljeborg, *Crust. ex. ord. tribus*, t. xxiv., figs. 1—13.

This species is readily recognized by the knotted appearance and peculiar arrangement of the setæ on the upper antennæ, and by the characters of the fifth feet, which, with their uncouth and gouty-looking conformation, are not easily described except with the aid of figures, for which we have

not space. It is identical with Mr. Lubbock's *Calanus Euchœta.* I have found it in the Channel Islands, Isle of Man, and Durham coast.

Temora finmarchica, Gunner. Claus, *Copepoden,* p. 195, t. xxxiv., figs. 1—11.

There seems to me to be no doubt that this is the species described by Mr. Lubbock (*loc. cit.*) under the name of *Diaptomus longicaudatus.* It is, without exception, the most abundant of the British Marine Copepods, at all events in littoral situations, where, during the latter part of summer, it often occurs in such swarms as to form quite a consistent mass when taken up in the net. Shetland, Durham, and the Channel Islands have all afforded me this species in great numbers.

Temora velox, Liljeborg. Lilj. *Crust. ex. ord. tribus,* t. xix. figs. 9, 10; t. xx., figs. 1—9.

Four British localities, all of somewhat similar character, have yielded this species. One, a pool above high-water mark, in the Isle of Cumbrae, Frith of Clyde, where it was taken plentifully by the Rev. A. M. Norman; the others, brackish pools in salt marshes at Hylton, about three miles from the mouth of the river Wear, at Burgh Marsh, near Carlisle, and at Hartlepool. In all cases sea water could find access to the pools only at the very highest spring tides.

Ichthyophorba denticornis, Claus. Claus, *Copepoden,* p. 199, t. xxxv., figs. 1, 3—9.

Ichthyophorba hamata, Liljeborg. Claus, *Copepoden,* p. 199, t. xxxv., figs. 2, 10—12.

In this case, as in that of *Cetochilus septentrionalis,* Dr. Claus has divided a previously established species, discarding, at the same time, the original name. It is difficult to decide to which of Claus's species Liljeborg's descriptions and figures (*I. hamata*) are meant to apply; it is, indeed, possible that both species have "sat" for the one portrait, but as, in most respects, the original figures of *I. hamata* agree with the new *angustata,* I have, on principle, retained the prior name. The peculiar fifth foot of the male (Fig. 4) separates the genus from every other, and the two species (besides minor differences) may be distinguished by the presence or absence, on the outer edge of the basal half of the superior antenna, of several strong toothed processes, these being present in *I. denticornis* and wanting in *I. hamata.* The two forms occur mostly intermixed, and I have them from Shetland, the Channel Islands, and the Durham coast. The genus is mostly pelagic.

Anomalocera Patersonii, Templeton. Baird, *Brit. Entom.,* p. 229, t. xxvii., figs. 1, *a*—*i*; 2, *a*—*c*.

A species first described by Mr. Templeton in the *Transactions of the Entomological Society,* vol. ii. (1837), and

afterwards, under the name of *Irenæus splendidus*, by Goodsir, in the *Edinburgh New Philosophical Journal* for 1843. Dr. Claus, in his recent monograph of the Copepoda, has adopted Goodsir's generic name, on the ground that *Anomalocera*,* which evidently has precedence, is inapposite, as all the family to which this species belongs have the males with dissimilar antennæ. But if we admit the right of authors to ignore prior names, merely on account of a fancied impropriety, which gives rise to no manner of inconvenience, we shall speedily have our nomenclature in a state of inextricable confusion. We therefore adhere to the original generic name of *Anomalocera*.

A. Patersonii is the finest of all the British Copepoda, both as to size and colouring. When alive it glows with a splendid iridescent lustre, the prevailing colours being blue, red, and green. The antennæ and caudal segments are mostly a brilliant blue, while the body is mottled with varying shades of red and green. The specimens from which our coloured plate was drawn were taken by the Rev. A. M. Norman, on the east coast of Scotland, in the summer of 1863, and having been mounted while alive in a gelatine medium, still preserve their colouring in its original brilliancy. The species seems to be distributed generally throughout the British seas.

PONTELLA WOLLASTONI, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

Of this species I know nothing. It is, however, in all probability, identical with *P. Helgolandica*, Claus.

PONTELLA BREVICORNIS, Lubbock. Lubbock, *Ann. and Mag. Nat. Hist.*, 2nd series, vol. xx.

A fine species taken by Mr. Lubbock at Weymouth, and by the present writer in the Channel Islands.

REFERENCE TO PLATE.

Fig. 1. Upper antenna of male *Tachidius brevicornis*, magnified 200 diameters.

Fig. 2. Lower foot-jaw of *Thalestris longimana* (copied from Claus).

Fig. 3. Upper antenna of *Dias longiremis*, magnified 60 diameters.

Fig. 4. Fifth foot (right) of male *Ichthyophorba denticornis*, magnified 50 diameters.

Fig. 5. Abdomen of female *Temora velox*, with spermatophores attached, magnified 40 diameters.

Fig. 6. Male *Anomalocera Patersonii*, magnified 30 diameters: *a*, rostrum, or beak; *b*, upper antenna (right); *c*. upper antenna (left); *d*, lower antenna; *e*, foot-jaws; *f f f*, swimming feet; *g*, fifth foot (right); *h*, fifth foot (left); *i*, abdomen; *k*, eye.

* From ανωμαλος, dissimilar; and κερας, a horn.

RETARDED EBULLITION—BOILER EXPLOSIONS.

Professor Dufour, of Lausanne, has a long and interesting paper on the "Retardation of the Ebullition of Water, and on a Probable Cause of Explosion in Steam-Boilers," in the *Archives des Sciences*, No. 83. We shall select the prominent passages, which will show the character of the facts which recent researches have made known in reference to these questions.

M. Dufour commences by observing that the law usually admitted as defining the relation between the boiling point of any liquid, and the pressure upon it, is subject to numerous exceptions. Gay-Lussac observed that the boiling point of water and other liquids was retarded by glass vessels. More recently MM. Marcet, Donny, Magnus, and others, have written on the subject, and Mr. Grove has described experiments in boiling water more or less deprived of air, and he has remarked that no one has yet seen the ebullition of perfectly pure water. Three years ago M. Dufour published an account of observations on water and other liquids heated in the midst of a fluid of the same density, and consequently withdrawn from contact with the solid walls of the containing vessels. Under such conditions water could be heated to 170° C., chloroform to 100°, etc. From such facts it appears that a temperature which gives to the vapour of any liquid a tension equal to the external pressure, is the minimum temperature at which it *can* boil; but the temperature at which it *does* boil will depend upon the conditions to which it is exposed, and especially those of contact with solids or gases.

After describing the apparatus which he employed, M. Dufour gives the following results:—"When after a first heating, not carried to the boiling point, the water is allowed to cool and arrive at a given temperature (t) : if the pressure is diminished until it becomes equal to the elastic force of vapour at that temperature, boiling occurs exactly at the point required by Dalton's law, or a few tenths of a degree below it."

"When the liquid has boiled for some minutes before being allowed to cool, and suffer the diminished pressure, sometimes it will commence ebullition the moment the elastic force of its vapour equals the pressure, while at other times ebullition will be retarded more or less considerably."

"When the liquid has been boiled three, four, five, or more times before being allowed to cool, and suffer diminished pressure, the retardations of boiling become much more frequent and form the rule not the exception, . . . some-

times exceeding 20° and even 30° C. After a third re-heating it is seldom that boiling occurs at the normal point."

Professor Dufour then tabulates his experiments, showing, according to the circumstances just explained, retardation of the boiling point ranging from 1°·7 C. to 23°·2 C. He then adverts to the well-known fact that the presence of platina wire assists ebullition; but he tells us that, "while it is rare, after a first or even a second heating, that water containing platina remains calm and liquid, when a diminution of pressure affords conditions under which it might boil; if it is exposed to prolonged and successive re-heating, retardations at last appear as in the preceding cases. The platina ceases to excite a change of condition, and behaves at the bottom of the water just like the walls of a glass vessel. We thus see what chemists have often noticed, that platina, having served for some time as a preventive against concussions, at last becomes inactive and the pieces of wire have to be renewed."

In former experiments Professor Dufour showed that globules of water heated beyond 100° C. when surrounded by other fluids of the same density, boiled furiously if touched with pieces of wood, paper, cotton, etc., and he now finds that, like platina, these various substances lose their power by frequent or continuous use. Partial renewals of the water occasioned diminution in the retardation of ebullition.

Professor Dufour remarks that, according to experiments hitherto made on the retardation of the boiling point of water, it has been supposed that this effect is only witnessed in vessels of glass or porcelain. He adds in a note, that M. Magnus records an instance of retardation in a vessel of platina, and goes on to say that when ebullition is excited by diminishing pressure, water in contact with divers metals retards its boiling point, and thus the mere contact of a metallic surface is not sufficient to counteract its tendency to maintain the liquid state.

"When water is in a state of retarded ebullition it presents, in appearance at least, no special activity, although a very abundant and exceptional surface evaporation is really going on. It looks motionless and calm; no bubbles of gas or vapour disengage themselves from the mass or from the walls of the vessel. This liquid condition is analogous to an instable equilibrium, and ebullition may supervene all at once. The sudden transformation of a portion of the liquid into vapour sometimes occurs without any appreciable external cause; but we are nearly sure of provoking it, by giving a shock to the vessel, and sometimes we can do so by admitting a small quantity of air. It is not rare to see ebullitions follow a tolerably loud noise, such as a blow struck in an adjacent

room, or the shaking occasioned by walking over the floor." Professor Dufour compares this action to the effect of agitation in exciting crystallization in super saturated solutions of sulphate of soda.

After reference to experiments of M. Marcet and others, the Professor observes that if the presence of a layer of gaseous matter on the surface of a liquid excites its ebullition, it must be interesting to know what effect would follow from keeping a gaseous layer constantly renewed on the surface of a body plunged into water. To ascertain this he immersed two platina wires in water, and rendered them inactive by repeatedly boiling the liquid. It was then possible to obtain retardation of the boiling point to the extent of 10° or 15° C. A galvanic current was then transmitted through the wires, and gases were continually evolved from their surfaces, and it became impossible to obtain the least retardation of the boiling point. The currents of oxygen and hydrogen starting from the two electrodes, acted as provocatives to ebullition, the moment the change of pressure rendered that phenomenon possible." When ebullition had been retarded to the extent of 15° or 20°, and was suddenly excited by the electric production of these gaseous currents, an instantaneous commotion occurred as if gunpowder had been ignited.

It might be thought the electric current and not the evolution of the gases occasioned these effects; but Professor Dufour thinks the following experiments show that the gas is the effective agent in the case. "When a certain quantity of water covered with oil is heated, by means of a bath, in a vessel of porcelain which has for some time previous held sulphuric acid, it is easy to obtain under a normal pressure a retardation of 6° or 7° C. If thin platina wires, that have been rendered inactive by prolonged contact, are introduced, the facts just cited may be observed, namely, retardation of ebullition so long as the current does not pass, and its excitation as soon as the current does pass. The ebullition thus produced commences immediately round the platina wires only, and not in the space between them that forms part of the circuit. If the platina wires are replaced by copper wires, also made inactive, ebullition commences about the negative pole only, where hydrogen is evolved; the positive pole where the oxygen unites itself to the copper, and where, consequently, no gas escapes, remains perfectly quiet, and is not the seat of any ebullition."

"When the electrolysis is continued for a few minutes, and the surface of the platina wires become covered with adhering globules of gas, which remain even after the interruption of the current, these globules gradually detach them-

selves, taking more or less time about it. Now, if it is only the contact with the gaseous globules that excites ebullition, this phenomenon ought to be seen even after the current ceases, and the wires ought not to become inactive till the current has ceased for some time. Experiments made in various ways show that this is the case."

When solids promote ebullition, Professor Dufour now considers it may be owing to the gaseous matter that adheres to them, and he thinks the power charcoal possesses of condensing gases on its surface, is the cause of its efficiency in avoiding commotions during the ebullition of many liquids.

"The phenomenon of ebullition," he states, "includes two actions: a disengagement of vapour throughout the mass of a liquid, which becomes passible as soon as the elastic force of its vapour is equal to the incumbent pressure; and the molecular action, obscure in its intimate character, by which the liquid is changed for the gaseous form." Contact with certain foreign bodies, and especially with gases, appears to give rise to this molecular action, and consequently to determine ebullition as soon as the state of pressure renders it possible."

Professor Dufour considers that this molecular action is distinct from cohesion, a force which opposes the division of a liquid mass into smaller masses of the same kind. Steam is not, he says, an *aqueous dust*, and in order to produce it something more than simple molecular separation is required.

Passing more immediately to boiler explosions, Professor Dufour observes that in a great many cases they occur when an engine is at rest, and when the boiler has experienced a certain amount of cooling. When this cooling occurs, it takes place most rapidly above the surface of the water, and has the effect of lessening the pressure of vapour that fills the upper part of the boiler, and then, although perhaps seldom, the ebullition of the water may be retarded as already explained, and be made to begin suddenly by any concussion.

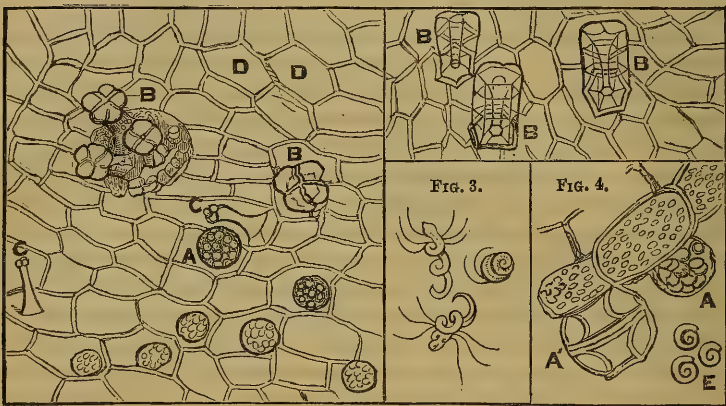
Small quantities of sulphuric acid materially help the retardation of the boiling point, and two explosions at Aberdare seem traceable to the employment of slightly acidulated water.

Professor Dufour considers that an apparatus to produce an evolution of gas by electrolysis, or an arrangement for the agitation of the water in boilers, might assist in preventing their explosion.

THE GERMINATION OF FERN SPORES.

BY THE REV. F. HOWLETT, M.A., F.R.A.S.

FIG. 1. 200 Diam. FIG. 2. 200 Diam.



400 Diam. 400 Diam.

FIG. 1. Portion of prothallium of *Filix-mas*. A, Antheridial cells; B, Archegonia; C, Sort of paraphysical filament; D, Ordinary cellular tissue, but granules of chlorophyll are omitted.

FIG. 2. Portion of prothallium of *Lastræa recurva*, with group of hexagonal lantern-like archegonia.

FIG. 3. Antherozoids of *Filix-mas* in various positions whilst swimming.

FIG. 4. Portion of margin of prothallium of *Osmunda regalis*. A, Immature antheridial cell with imperfect antherozoids; A′, A full-grown but empty cell; showing the way in which the antherozoids (E) lie spirally curled up in the water, upon first emerging from it.

To any one possessing a fairly good microscope, and who is desirous of witnessing some of the most curious and beautiful phenomena that are to be found, perhaps, within the whole range of natural history, a method shall be described in this paper whereby a rich fund of interesting botanical research may be provided for the ensuing spring and summer, within wonderfully limited territories, and at a very trifling expense.

It is true, a little trouble and care are requisite in the investigation, but, to an intelligent lover of nature's microscopic wonders, the results will be well worth the pains bestowed upon it.

Our subject is the germination and development of the spores (or seeds, as they are sometimes though not quite correctly termed) of different species of those elegant cryptogams, the Ferns. A paper on the same subject appeared in the

29th number of the INTELLECTUAL OBSERVER (for June, 1864), from the pen of Mr. R. Dawson, M.B., wherein, amongst a good deal that was interesting and instructive, certain statements were put forth by that writer which certainly demand a few words by way of reply.

But, first, as to the method of observing the phenomena in question.

Having provided oneself with one or more of the round shallow glass troughs, with bell-glasses to match, such as are manufactured at a very reasonable cost by Messrs. Claudet and Houghton, of 89, High Holborn (and called by them propagating glasses), let the troughs be filled about an inch or so deep with clean river-sand. If sea-sand be employed it must be scrupulously cleansed by repeated washings in spring water, to get rid of the salt. Next, having prepared as many small lumps of porous sandstone, each about 1½ inches square, as you wish to have species of ferns, and having conspicuously scratched a number on each (Roman numerals are perhaps most convenient) for the purpose of identifying your future plants, dip them in clean spring water, and place them on a table which is not exposed to a draught. Then sprinkle separately a *very* small quantity of fern spores on each of your pieces of sandstone—having, of course, previously collected the spores by placing a portion of the mature fronds, whilst in fructification, between separate sheets of note-paper, and preserving the spore dust which will be discharged from them.

Great care is requisite in order to prevent the mingling of the extremely light and almost invisible spores; and it is expedient to open only one packet at a time, dipping a *separate* small feather, or morsel of paper, into one packet after another, and gently rubbing therewith the upper surface of your pieces of sandstone; and, as another precautionary step, it is moreover rather desirable that the stones should be freshly fractured, or at least the surfaces rubbed to a new face, as sporules of various kinds of mosses, *Marchantiæ*, etc., are very apt to establish themselves upon fragments of stone picked up at hap-hazard by the wayside.

Then saturate the river-sand in your troughs with spring water, till it is of about the humidity of mortar, arrange your pieces of stone thereupon, so as you can most conveniently see the numbers, a list of which, specifying the different kinds of ferns, date of sowing, etc., may be advantageously pasted outside your bell-glass for reference.

Place the glasses in a tolerably warm room or greenhouse, but where they will not be exposed at any time to the direct rays of the sun, and after a few days or weeks (according

as the temperature or season of the year may vary) each piece of stone will be seen to be covered with a delicate green efflorescence, like the fine pile of a velvet, or plush. These are the germinating spores—called in this stage, and for some months afterwards, prothallia, or first-leaves; though, indeed, the stones should occasionally be submitted for a brief while (so as not to suffer them to get too dry) to the microscope before any such green efflorescence becomes visible to the unaided sight, inasmuch as the very first stage of growth (which it is of importance to note, it being a moot point as to whether germination takes place indifferently, or not, from *any* point on the surface of the spores) is quite imperceptible without the microscope.

Instead of, however, taking the pieces of stone from off their moist bed of sand, it is a better plan to scrape off a few of the spores from time to time with the point of a scalpel, and submit them to a moderate microscopic power, say $\frac{4}{10}$th object-glass, to see how they are getting on. It may be observed, in passing, that the spores would germinate readily if the stones were simply placed in a trough of water—but then the slightest disturbance of the vessel containing the miniature plantation would infallibly cause the spores to be washed about, and to be commingled; unless, indeed, the stones were of a cumbrously large size.

But, supposing the spores to have duly germinated, now comes the wonderful part of the story—so wonderful, indeed, that it is not surprising that it has been doubted by Mr. Dawson, and perhaps others, who have not been fortunate enough to witness it; though the writer of this paper, during the six years that have elapsed since he first turned his attention practically to the subject, has verified the phenomena scores and scores of times, and has had the pleasure of showing them to numerous friends, amongst whom he has the honour of including one of the profoundest philosophers of our or, indeed, any other time, the gifted Sir J. W. Herschel, and who expressed himself as much struck with what he had witnessed.

When the prothallia are sufficiently advanced in their growth, and which circumstance will vary, as we have said before, according to the different amount of temperature they may have enjoyed, and to the different periods of the year (the phenomena about to be described being rarely or never seen, so far as the writer has observed, between October and March), small circular vesicles, each about the size of the whole original spore, will be seen to stud either the edge or the under surface of the little prothallia; which last will be observed to assume very different forms, being regulated in this

matter partly by their species, and partly by the density or sparsity of their growth. Very frequently, and especially amongst others, in the cases of the golden fern (*Gymnogramma aurata*), of *Strathopea germanica,* and the noble British fern, *Osmunda regalis,* these vesicles will be found to be most conveniently and conspicuously placed upon the very *edge* of the prothallia, and consequently in the best possible situation for microscopic examination. These are the "antherozoidal cells," and being as transparent nearly as glass, their contents are perfectly revealed under a good microscope. Before they are quite mature they will be seen to be filled with crowded semi-transparent greenish granules, which become more and more pellucid as they approach maturity, until at length they are each seen to assume a distinct form, something like a minute transparent spiral shell, and to each occupy a separate cell within the common enclosing vesicle.

If now, when thus mature—and the *successive* arrivals of the prothallia to this stage extend over months, from one single sowing, and from off the same piece of sandstone, so that sooner or later they cannot fail to be in the right condition; if, when thus mature, two or three of the prothallia are carefully picked off the damp sandstone by means of a needle, and immersed in a drop of *water* between two pieces of glass, the little spiral shell-like bodies will in a very few minutes be seen to start out, somewhat suddenly, from the extremity of their enveloping antherozoidal vesicle; and after lying quietly in the water for one or two minutes will then unfold themselves, and assuming a corkscrew sort of form will launch away into the circumambient fluid, and wheel and sport about as merrily as a swarm of gnats on a summer evening! Anything more like voluntary and vital action (animal vitality) it is impossible to conceive; and the analogy indeed which they bear, there can be little doubt, to certain phenomena in the animal economy, will strike every microscopic anatomist, and may well excite our admiration of that harmony of design, and unity of purpose, manifested throughout nature by the great Author of all things. For other marvels yet remain to be told respecting these antherozoids. Some one or other of these erratic atoms meet with another cellular organ, called the archegonium, either on their own or some neighbouring prothallium; and, according to the testimony of Sumniski and Mercklin, as quoted by Mr. Dawson, and of Hofmeister, as quoted by Dr. Carpenter (see *The Microscope and its Revelations,* page 404, ed. 1856), they have been seen to descend down a narrow orifice in the same, until reaching what is believed to be the germinal-cell at the bottom of the archegonial shaft, they fertilize the cell; in like manner as the pollen from the anther of a flower

fertilizes the germ-seeds through the channel and instrumentality of the stigma and pistil.

The author of this paper has never yet actually witnessed the descent of the antherozoids into the archegonia; though the latter organs, along also with the antherozoidal vesicles, and the antherozoids themselves, are all distinctly visible in certain specimens of the prothallia of *Filix mas* immersed in a solution of acetate of alumina and distilled water, and mounted permanently for the microscope; and which have now maintained themselves in a state of perfect preservation for about four years. See Fig. 1.

That the archegonia are truly thus fertilized, seems to be shown from the fact that the true rhizome and fronds of the young fern are always seen to spring, eventually, from a point immediately in contact with one of the archegonia, situated near the upper part commonly of the prothallium, and (as in the case of *Filix mas* and others) on what would be its central line, did any such line exist, but which does not.

The antherozoids, when set free, may be seen as spiral, club-headed organisms, furnished near the thickest part with six cilia, with which they vigorously propel themselves with a peculiar wriggling, jerking motion, through the water. But both these undoubted facts, as well as the fertilization of the archegonia by their instrumentality, are considered as too romantic by Mr. Dawson. "The compromise," he says (see INTELLECTUAL OBSERVER for June, 1864, p. 337), "between animal and vegetable impregnation is too obvious to be real; besides, what are the cilia and curved tail for? impediments rather than aids to going down a straight tube; and cilia are for swimming, but where has the Leander to swim to his Hero?"

To this, the author of this paper replies—"Because it is *requisite* that the antherozoidal bodies *should* swim, therefore we see that they *are* furnished with cilia! I have witnessed all these facts repeatedly, with one of Messrs. Smith, Beck, and Beck's magnificent first-class microscopes, now in my possession, with even as low a power as 60 diameters. And as to the question, 'Where has the Leander to swim to his Hero?'—if by this is meant, where is his Hellespont? I would answer thus—paraphrasing the well-known beautiful, but rather boisterous glee—

> **"Of water alone he wants no more**
> **Than the prothallium supplies,**
> **When a dew-drop lies**
> **On its leaf, on a summer morning!"**

And again, writes Mr. Dawson, "I have carefully observed these bodies" (the antheridia, he means, and archegonia),

"which are clearly to a demonstration nothing but roots and stomata in all stages of development; * * * but that they" (*i.e.* the antherozoids) "have tails and whiskers is pure imagination." If Mr. Dawson, nevertheless, or any other gentleman will spend an hour or two with the author of this article, next spring (if spared to see the "green leaves come again"), he will go away without any shadow of doubt about the stirring fact of those masculine appendages to the antherozoidal bodies!

But one word more, as a critic, and that with respect to the doubt expressed by Mr. Dawson, as to whether it be true, as stated by Balfour, Moore, Carpenter, Lindley, and Hofmeister, that germination takes place indifferently from any point of the surface of the spore, and not from fixed points. The writer must confess, and that with great diffidence, in the face (if it be really so) of such high names, that he does somewhat participate in Mr. Dawson's doubts; though he may, very possibly, soon have to retract even this modicum of dissentient opinion. And now his attention is called to the point, he will find, probably, but little difficulty (owing to the abundant means for investigation at his command) in satisfying both himself and friends on this question; his only reason for at all demurring to the opinion of the eminent writers above mentioned, arising from the peculiar forms and ornamentation of certain fern spores, which would seem to bespeak a special relationship and subservancy of parts one to the other, and not an indefinite one as regards germination.

It may be observed, lastly, that whatever ferns may do when left to natural circumstances in their native haunts, they only attain their growth very slowly when propagated on sandstone under bell-glasses. At least, spores of *Filix mas* and *Pteris tremula*, for instance, which were sown in the early spring of 1859, and potted in 1862, only began to exhibit fructification on their fronds in July 1864. On the other hand, whilst probably not one fern-spore in a million (if that proportion, even) germinates when left to nature, nearly every one of them will grow when under the artificial treatment described in the preceding pages. It is, not, however, to be concluded that the countless millions of spores which fail to germinate do not fulfil some more or less important part in the hidden economy of Nature.

A BRIEF HISTORY OF A RIVER TANK.

BY SHIRLEY HIBBERD.

An object with which most of my friends are familiar is a plain rectangular tank, containing rockwork, water, and gold fishes, and which occupies a conspicuous place in the entrance-hall of my residence at Stoke Newington. It is such a very unpretending affair that I dare say many of my friends will at this stage of my "brief history" think that I have made a mistake in selecting such a subject for a paper in the Intellectual Observer, but if they will just read on, I have no doubt I shall be able to satisfy them that my tank is an object of some interest, not only to myself personally, but to the cultivators of aquaria everywhere. In the *Book of the Aquarium* I have endeavoured to expound the "natural system" of tank management, which, as its name implies, is the only system by which satisfactory results of a permanent nature are to be obtained. The history of aquaria in the most extensive sense, is simply a history of the rival pretensions and diverse results of the artificial and natural systems of management. The artificial system is, perhaps, no system at all, because the practitioner seeks merely to gratify his fancy in forming an assemblage of aquatic plants and animals; the tanks are elaborately decorated with fountains, grottoes, and banners of vegetation, and stocked with crowds of fish.

Under some circumstances the artificial system answers admirably; in others it is a failure from the first, and every repetition of the experiment ends in the same disappointment. For all show purposes the artificial system is invaluable. It has often been my lot to exhibit tanks at soirées, converzaziones, etc., and they have always been greatly admired; but so thoroughly artificial have been the arrangements that I have sometimes taken up from the garden tufts of *Holcus saccharatus*, *Arundo donax*, and other large plants of graceful habit, and, having washed the earth from their roots, have planted (*i.e.* fixed) them in good positions, *pro tem.*, for crowds of gold fishes, minnows, bleak, etc., to gambol amongst. I remember some years ago, when visiting Leeds to deliver some lectures on aquaria, I had the privilege of inspecting the tanks of Dr. Hobson, which were the most satisfactory exemplifications of artificial management I had then or have since seen. A very elegant room was appropriated to a series of vessels, in which was kept up a constant and copious run of water, the stream passing from tank to tank, the tanks being in a succession of levels, so that from one end of the room

all were visible in an ascending series, which produced an agreeable *tout ensemble,* and at the same time made one source of water supply sufficient for the whole. This was a strictly artificial arrangement, but it was perfectly successful. The tanks were all well stocked with fishes, reptiles, insects, etc., classified according to their habits and proclivities, and so grouped that when viewed collectively, the scene was beautiful in the extreme. One more instance of artificial management for show purposes will, perhaps, suffice. When lecturing at the Reading Institution some years ago, I had an accident, and spoiled nearly all the sea-water that had been secured for the display. But I was not to be beaten by trifles. I had enough sea-water left to fill a few large shallow glass pans; into these pans I transferred the anemones, star-fishes, etc., and gave them just enough water to cover them, and in the show tanks I grouped the large handsome specimens of algæ that had been collected for the purpose, so as, with serpulæ shells, rocks, etc., etc., to make handsome groups, and filled those tanks with water drawn from the Institutional water-butt, and kept the secret to myself from that day to this. That was a perfectly successful undertaking; the tanks looked beautiful by gaslight, with their grand groups of algæ, and as for the animals, the thin film of water over them, and their recent travel and subsequent transference from their places in the tanks, caused just enough of that peculiar irritation which seems to be needful to cause a full display of the beauties of certain of the Radiates, and the audience had the advantage of beholding star-fishes, plumose anemones, and other marine subjects, in the attitudes they habitually assume when safely anchored fathom deep in ocean brine.

The natural system is an imitation of nature, not in outward appearances merely, but in *conditions.* Tanks managed on the natural system may be made to have a most beautiful appearance, and I flatter myself that the example I am now to bring before you could not be easily surpassed for beauty, considering it simply as an appropriate item in a "home of taste." But it is impossible to use such vessels for show purposes; any disturbance of the furniture would be a violation of the most essential conditions, and mere decorations are not to be tolerated; they are, in fact, forbidden by the laws on which the system is based. How do we proceed to carry out the natural system? We form within a vessel or vessels a group or groups of objects in imitation of rock-pools, running streams, lakes, ponds, and so forth. If it is intended to keep in any of the vessels creatures that habitually dwell in mud, there must be a bottom of mud for them. If retiring places and dark recesses are needed, they must be built; whatever is to be the

purpose of any particular vessel, it must be prepared in the first instance so as to contain within itself all the conditions essential to success, and when it is completely stocked it must be left to take care of itself; and if it becomes unsightly, or the animals become diseased and perish, then in that particular instance the natural system has failed through some error or oversight of the practitioner. Of course in all this there is much that is artificial; for instance, it is artificial to put fishes into glass vessels of any kind, and very artificial to build miniature caves and grottoes of coke or broken bricks; but the term natural system is nevertheless quite legitimate, because the endeavour at every step is to illustrate the operation of natural laws; whereas on the other system the endeavour may be simply to carry out a fanciful device, or a scheme which in its first elements sets the laws of nature at defiance.

The tank I have to describe was fitted and furnished more than seven years since. It is a simple rectangular vessel, in form nearly a double cube, and its position is in the entrance-hall adjoining the rear wall, where it is sufficiently illuminated to render every part of its contents agreeably visible to the eye, yet it receives scarcely any direct light whatever. It is impossible there should be anything more simple than the furnishing of this vessel, yet it does not lack certain features that render it attractive to unscientific eyes. I fitted it myself, and proceeded as follows:—I procured from the cellar a number of large pieces of coke, some of which were broken, to afford ample choice of blocks of various forms and sizes. Those were preferred which had a somewhat rugged face, but which nevertheless were large and flat, giving plenty of linear surface, so as to be best adapted for building a wall of very moderate thickness. These were two or three times dipped into a thick batter of Portland cement, and were finally cemented together in blocks of suitable width for convenient lifting, with one or two empty flower pots at the base and within every block. The flower pots were used to create a flat basis, so that each block would rest on the bottom of the tank securely, and for the additional reason of the increased lightness of the blocks so constructed, the fronts being made solid and massive, yet hollow within, and the pots not at all or only slightly covered with rock on the sides intended to form the backs of the blocks. Thus a rugged wall of rock was formed in a series of detached pieces, massive in appearance, yet of no greater weight than admitted of convenient lifting. Such a wall made of mica schist—which is the best of rocks for aquaria where its weight is of no consequence—would soon have ruined the tank, and perhaps have brought down tank and stand within a few hours of the first fitting. With coke and flower-

pots you may build another Tower of Babel, and its weight would scarcely make an indentation on a newly-ploughed field.

The rocks were, as soon as tolerably hard, placed in a large vessel of water. A tank in the garden used for ordinary garden purposes, answered admirably for the soaking process that all newly-cemented work must undergo before it should be used in an aquarium. The only preparation the tank itself underwent was to colour the back, so that glimpses of the wall should not be seen through any possible interstices of the rockwork. I took some sheets of green tissue paper, smeared the back plate of the glass all over with copal varnish,

pressed the paper smooth on it, and by that experiment determined that if it ever becomes needful to colour one side of a tank, the paper and varnish is the most effectual and cleanly that can be adopted. In due time—a fortnight perhaps, not less—the blocks were taken from the bath and placed in position. A bottom of clean well-washed pebbles was laid down, the tank was then filled with water, and the gold fishes and minnows were introduced.

That is nearly all that has been done to the tank from that day to this. Yet a few things remain to be said. In the first place, it has been a complete success, and the nature of that

success may, perhaps, surprise some of our non-successful aquarians. For instance, the water has never once, during a period of over seven years, been pea-soupy, or even cloudy, or otherwise than as brilliant as all that we have in our mind's eye when talking of the "crystal spring" and the beverage of Castally. There have been deaths in it—deaths by compulsion, the result solely of experiments made with a view to test the extreme capabilities of the system; but there are in the tank at this time gold fishes that I have had in my keeping, and that have never been otherwise than healthy and happy, during a period of *more than nine years*. If any of our readers have kept gold fishes in glass vessels as long or longer than I have, I should much like to hear of it, and with the fact a word as to the conditions. Furthermore, to keep this tank in order is a matter of such small trouble that it may be literally said to take care of itself. Ordinary dusting and occasional cleansing of the exterior are, of course, necessary, and for the interior there are two operations only that are needful. The fishes are fed with rice boiled in water, or with bread crumbs. I believe that bread is as good a food as they can have, and as it is always handy, it is a great advantage to be able thus simply to perform a duty which is generally too much neglected, for there are still to be found some benighted people who think that gold fishes can live on the invisible tenants of the tank, and get fat, as it were, upon nothing. The other operation is the occasional cleansing of the front plate inside. This is accomplished by means of a piece of sponge, attached, by means of twine, to the end of a stick, and the stick is thrust behind the tank, so as to be always handy for the purpose. This cleansing of the front plate is performed about once a fortnight during summer, and not more than once in three months during winter; in fact, it might be left undone from November to March, and the view would be unimpaired by even the slightest film of confervæ; but from March to October the growth is sufficiently rapid to produce a perceptible green tinge on the glass in eight or ten days, and this is easily removed by the sponge. In cases of long neglect I find the most effectual mode of cleansing to be with a cloth on which a little silver sand is sprinkled; this, drawn over the glass with the sand, brings away the crust at once, and if carefully done, appears not to cause any serious scratching of the glass, though if the glass were of poor quality, perhaps it might.

The reader has of course taken note of the omission from this history of all mention of the introduction of plants to the tank. I have never introduced a plant of any kind, yet the rocky wall is richly coloured with microscopic forms of vegetation in beautiful green, bronze, and russet patches, and if the

glass ends are left untouched, they in time become quite opaque with a dense coating of olive-coloured vegetation. This is one of the grand features of the natural system. I may introduce a thousand plants, Anacharis, Valisneria, Stratiotes, etc., etc., and they may all perish. But those Dame Nature introduces are sure to live. Being developed *in situ* they are of constitutions adapted to the conditions which exist in the tank, and though it requires a long time for a vessel, *situated as this is*, to become richly clothed with suitable oxygen makers, some supply of oxygen is secured from the very first, for I have seen ciliated spores and beginnings of genuine vegetable deposits within a few hours of the first furnishing of a tank. Hence it was that, fortified by previous experiences of the natural system, I did not hesitate to introduce the fishes as soon as the tank was furnished, without waiting for the full development of the microscopic forest, for I knew that before the fishes exhausted the oxygen in the fresh river water, there would be the beginning of a new supply for them, and there was never any distress through that procedure.

I have italicised above the words "situated as this is." The situation of this tank is the secret of its success. Near it on one side is a window facing west. This window lights the hall abundantly, but very few rays of light from it fall directly on the tank. The only direct light which strikes upon the tank comes from the fanlight over the door directly opposite, and that is, of course, but moderate in amount. Now, in the early days, when I wanted a quick growth of Oscillatoria, and other oxygen makers, I had the blind drawn up at the side window, and there was then no fern case there. The abundance of light caused a speedy diffusion and germination of spores, and as soon as I saw that the vegetation was likely to be too plentiful, I had the blind drawn down, and intercepted the light that still came by means of a fern case. Thus by toning down the daylight, and having my tank where an excess of light was impossible, I secured a moderate, yet plentiful growth of plants, and have never had one vegetable filament more than needful, except on the front glass, where of course it intercepts the view of the interior. It must not be supposed, however, that the hall is dark in consequence, it is, in fact, well lighted, and very cheerful.

Now a word for the fishes. I find that for a vessel of this sort, which though to me an experimental and scientific affair, is in all other respects a piece of elegant furniture, there are no fishes that may be kept with such certainty as gold carp. My old friends of nine years' standing (or swimming) have gone through several severe trials and seem none the worse. I cannot say how much they have grown during

this long period; but I think they have grown, though certainly very little. They are tame and lazy, and happy and beautiful, and they have served an important purpose to me besides the adornment of the hall, for, after their seven years' habitation of this tank, having had two years of active experimentalizing previously, they have solved the problem of the cubic space required by a fish for breathing room, and I shall be able to give a safe rule for the guidance of all cultivators of aquaria. I have arrived at the maximum capacity of my tank in various ways. One way was to introduce occasionally a few new fishes. As common carp abound in a pond close by, a good many have had temporary residence in the tank. Minnows have been used in the same way, and I have also added gold carp, and other fishes which are generally tolerably adaptable in constitution. But it always happened that when the fishes exceeded a certain number there were signs of distress. I could not begin changing the water to obviate this, because that would be to annihilate the natural system "at one fell swoop." No, the water has never been changed during the whole seven years, though, of course, it is necessary occasionally to make good the loss by evaporation. But I did try on a few occasions of extreme distress to aërate the water by the use of a garden syringe. Charging this from the tank the water was ejected back with force through some slight atmospheric distance, carrying streams of bubbles to the bottom of the vessel. This would be amusing, because the fishes would rush at the streams of bubbles and absolutely gulp them; but it was fagging work, and, of course, was only performed by impulse and not by system. The end of every one of these experiments was the same. One or two of the newly introduced fishes would, after the lapse of about a fortnight, be found dead and "floating on its watery bier." Next a few more would die, and so on till the whole of the new comers were cleared off, and the old, well-seasoned members of the "happy family" remained unhurt, but breathing more freely for the relief, and no doubt rejoicing to have got rid of the innovators. Suppose now that you have some gold fishes, averaging four to six inches in length, to preserve for any length of time by the natural system, and under circumstances at all resembling the case here described, for half-a-dozen of those fishes you must have a vessel holding at least twenty-four gallons of water. The smallest of your fishes will need three gallons, all larger four or five gallons. Most of the failures in tank management have resulted from over-stocking, but the modification of the light is an equally important matter.

The natural system can be carried out in marine tanks in much the same manner as in river tanks, though, of course,

the cases differ in many respects. In a marine tank which has been in operation four years, and is scarcely ever touched or disturbed in any way, I have some British mollusks that were introduced in the first instance, still in perfect health. During the very hot weather of the past summer I lost two or three periwinkles, but I have still several of the periwinkles living, after four years' residence in the vessel, and during the whole of that time there has been no vegetation except such as is strictly microscopic.

NOTES ON FUNGI.—No. I.

BY THE REV. M. J. BERKELEY, M.A., F.R.S.

A few years since there were scarcely half a dozen persons who made Fungi an object of study, or who were at all aware of their importance in the economy of nature. At present, thanks to the popular work of Dr. Badham, and to more scientific helps which were previously unattainable in our own language, there is a growing desire to become more intimately acquainted with them, a desire which is checked only by the extreme difficulty of the study, especially of that more important division Agaricini, which comprises a great part of the species which are used for food, or respecting which a mistake may lead to fatal results.

Every accident, however, which arises from the use of dangerous fungi is not attributable to ignorance. Peculiarity of constitution, or, as it is called in the language which is frequently so annoying to judges in the course of trials where medical evidence is necessary, idiosyncracy, has a great deal to do with it. The incompatibility of every kind of shell-fish with some constitutions is notorious; and I know an instance where the smallest quantity of egg acts as a pernicious ferment, inducing a variety of unhappy consequences. This, however, is not all. The cases of death or illness from fungi mostly arise among the poorer classes; and it is not wonderful if, after a hard day's labour, when a pound or more of coarsely dressed mushrooms is consumed without due mastication, a severe fit of colic or dysentery should take place. Where the esculent Agarics are consumed in moderation and eaten with a proper quantity of bread, I believe that they are perfectly wholesome, as Wildenow found them when living on them for weeks to the exclusion of other food, except the coarse German bread.

The prejudice against anything except the common mushroom, and a particular form only of that, is so strong in this country amongst the poorer classes, that there is little prospect of their availing themselves of the bountiful feast which is prepared for them in the fields—a prejudice so strong, that even amongst educated people I have known instances in which persons had arrived at thirty years and upwards who had never ventured to taste even a mushroom. There are, however, numerous persons who wish from curiosity or from some better motive to become accurately acquainted with these productions; and it is with a view to facilitating their studies that these notes are commenced with the genus Agaricus, to the exclusion at present of the more nearly allied genera.

The genus Agaricus numbers in the *Outlines of British Fungology* above 350 species, and it is probable that when the British isles have been thoroughly investigated, 150 more may be added to the list. The difficulty of ascertaining any particular species amongst so large a number, where the distinctions are often very subtle, can scarcely be exaggerated; and yet a few plain rules will remove a great part of the difficulty.

The division Agaricini is distinguished from others by the fructifying organs being disposed on certain gill-like plaits or veins on the under surface. In a few rare instances this surface, or, as it is called, hymenium, is turned to the light in the course of growth, though originally inferior. Several genera are comprised in the group, distinguished by their corky, leathery, waxy, or extremely deliquescent consistence; by their having a veil attaching the pileus to the stem, appearing to the eye as if composed of threads like those of a spider's web; by the interior substance of the gills, whether abounding with a milky juice or otherwise, consisting of little vesicles instead of threads; by the gills being reduced to veins, or by one or two other distinctions which are of little importance as regards British species. The genus Agaricus, comprising the true mushroom, with a multitude of other wholesome species, remains characterized by membranaceous persistent (not deliquescent) gills, their interior substance filamentous and continuous with that of the pileus and their generally acute edge.

Having then obtained something like a correct notion of what a true Agaric is, and being able at once to distinguish the genera, which might most easily be confounded, as the milk-fungi Lactarii, the rigid brittle-gilled milkless Russulæ, the spiderwebbed Cortinarii, with their spores resembling in colour peroxide of iron; the waxy Hygrophori, which adorn our heaths and open meadows with the most brilliant hues;

the tough Marasmii and Pani, which dry up rather than corrupt in decay; the Paxilli, with their gills separable from the pileus; and, lastly, the inky fungi, which in a few hours pass into a black ink-like fluid, though some of these even are esculent in a young state, the student with a real Agaric in hand has to determine to which of the numerous divisions in the genus his species belong.

Now there is a character which will at once enable him to refer it to one of six great groups into which Agarics have been so cleverly divided by Fries—a character which, though like other characters in natural history, is not absolute, but accords with the real affinities of these plants—I mean the colour of the spores. A very little practice will enable the student at once to say to which great group any particular species belongs; but till this tact is acquired, or where doubtful cases arise in the course of more advanced study, it will be well to collect the spores by simply placing the specimen on a sheet of white or black paper, inclosed in some vessel which excludes the air. In the course of a few hours there will be a thick deposit, unless the specimen is too far advanced, or has become dry from exposure to the sun. The spores will be found to be either white, or pink, or ferruginous, or brown, or purplish-black, or black, according with the divisions Leucospori, Hyporhodii, Dermini, Phæoti, Pratellini, or Coprinarii. Amongst the Leucospori in a few instances the spores will have a slight tinge of yellow, or possibly of pink, but not of so decided a character as to invalidate the importance of the distinction; in Dermini there will be different ferruginous shades, partaking more in one case of yellow, and in another of a red tint; but there will be no real difficulty, and the peroxide tint of the spores of Cortinarii will be distinctive enough even apart from the spidery veil. The spores themselves will not very frequently present distinctive characters; but two prominent forms will be found in Hyporhodii, distinguished by great neatness of outline and extreme irregularity; while amongst the Dermini cases will be found where they are studded over with granules, presenting an excellent mark of distinction between species which might otherwise be difficult to separate.

The student having thus ascertained to which of the six main divisions his species belongs, will proceed to the characters of the sub-divisions, or sub-genera. It appears greatly preferable to consider them as sub-genera than as genera, as it keeps the whole under one common view, and there is really no less difficulty in the one case than in the other, though something of the kind is often alleged as an excuse for multiplying generic names.

Before, however, he proceeds further it will be well to have

some mode of preserving specimens for comparison. Now it is true that the softer fungi cannot be preserved as satisfactorily as most Phænogams, but with care they will make useful specimens for the herbarium. If gathered in moderately dry weather, and dried like other plants, after a day's exposure to the air, they will often, if the papers are changed frequently, and well dried before each change, make tolerable specimens. Thin sections may be prepared in separate papers, and both together, after being well washed with a solution of corrosive sublimate, when glued on paper, will give all the principal characters, and the point of a lancet will always enable the student to remove spores enough for microscopic observation. The collection will, however, require frequent inspection, especially to guard against the ravages of mites. A dry room is essential; but apart from this, if the drawers are lined with cedar, few insects, if any, will appear, and a free use of pure benzole will soon destroy any that may resist the cedar. Moulds, perhaps, may be more difficult to guard against, but frequent inspection and a dry atmosphere will do much.

As regards the mode of keeping the specimens, far the best way is to have slips of paper which are multiples of some convenient unit, on which the specimens can be glued according to size, and the slips can then be fastened to sheets of the common herbarium dimensions.

In the next set of notes the characters of the different groups of Leucospori will be given, with notices of the most approved and safe esculent species, as also of those which have been clearly ascertained to be poisonous or deleterious.

THE LUNAR ARCTIC REGION: MARE FRIGORIS: MOUNT TAURUS: POSIDONIUS.—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

In our previous description of the neighbourhood of the N.W. lunar limb, we broke off without reaching the Pole. We must therefore now turn our steps in that direction. As a necessary consequence of the very slight inclination of the lunar axis, the arctic zone, properly speaking—that is to say, the region around the Pole where the sun never rises in winter and never sets in summer—is of much less extent on the Moon than on the Earth; its radius being only about $1\frac{1}{2}°$, instead of $23\frac{1}{2}°$. But, as Beer and Mädler observe, this would by no means produce a greater equalization of mean temperature than upon the earth. The question, however, of the distribution of lunar climates and their analogy with those of our own globe is a difficult one, being complicated with the absence of any dense atmosphere, which on the earth materially diminishes the force of the oblique solar rays, and, as we have now learned from Mr. Glaisher's balloon ascents, produces meteorological effects not hitherto fully taken into consideration.

As we approach the Pole we find in the Full Moon a multitude of converging luminous streaks, the major part portions of great circles, but some of irregular curvature. Their point of union is the ring-mountain *Anaxagoras* (No. 46, in the next quadrant).* These streaks, as B. and M. observe, pass over every inequality of ground alike, and are not at all elevated above the adjacent soil. This they satisfied themselves of as fully in this district as elsewhere, by watching their aspect on the terminator, where a bank of less than 150 feet high must have come out in its true relief.

Strabo and *Thales*, two craters of moderate size, will be found close to each other; the latter, which is the more easterly, being the more regular, steep, and brilliant of the two. *Strabo* lies about its own breadth distant from *Endymion* towards the Pole. Some short streaks issue from *Thales*, one running eastward having a very defined edge, like the shore of a sea, on its N. side. When a favourable state of libration brings these objects away from the limb, their aspect is a striking one; the effect of local shading causing *Thales* to stand out as a commanding height, in cold and barren insulation.

N.W. of *Thales*, and considerably nearer to the limb, lies a crater undescribed and unnamed by B. and M., and not

* See Index Map of the Moon, vol. v., p. 190.

made sufficiently prominent in their map. Its long-enduring shadow, however, under a favourable libration, proves it to be a very important object, and one of the leading features of the district, and it would be desirable that it should receive a suitable designation in the enlarged nomenclature which Mr. Birt is engaged in carrying out. This portion of the Moon does not bespeak any especial care on the part of B. and M. It should have been noticed in our last paper that, though they have drawn, they have not described two curious streaks S. of *Hercules,* which distinctly converge upon the little bright crater in its interior, though they are lost before they reach the external foot of the great wall. Between *Geminus* also and *Thales* is a curious arrangement of light and shade, neither drawn nor mentioned by them. As to drawing there is little to be said. It was a hopeless undertaking to combine in one representation the local colouring of the lunar noon with the true relief developed by the shades of morning or evening. A separate picture is wanted for the Full Moon, a chart or diagram for the phases. It would, however, have been more satisfactory to have found some account of a fine broad streak, somewhat like the tail of a comet, which I have seen 3d. 15h. after First Quarter, 5d. 22h. after greatest S.W. Libration, passing from the region of *Geminus* just S. of *Struve,* and forming the S. shore of the *Mare Humboldtianum,* of which it seems to flatten the curve. Between this place and *Endymion* it is subdivided into two or three narrow rays, and between *Mercurius* (a considerable crater N. of *Struve*) and the *M. Humboldtianum,* it is crossed by another remarkably thin, straight, and even streak; the intersection of the two forming a patch of light more brilliant than either of them separately. This is a suggestive circumstance and worthy of attention. The last-mentioned streak is of considerable length; its actual bearing upon the Moon is probably S.S.E., and not far from perpendicular to the other, though foreshortened into great obliquity of position: it becomes gradually invisible either way; in one direction between *Struve* and the limb; in the other, beyond *Endymion,* where if it is not lost, it bends more to the S., or perhaps another ray takes up its course and runs into *Thales.* All this, of which no note is to be found in B. and M., is merely a specimen of what is to be met with in many regions in the high illumination of the Moon.

At some distance E. from *Thales* we come upon a district remarkable for a network of intersecting ridges, by which it is mapped out into separate areas, of various, occasionally even rectangular forms. There seems little difference of level or colour: the ring-mountains which occur are flat: craters, some of them of great brilliancy, have broken alike through the ridges and the plains. Still further N., B. and M. have spoken

of the impossibility of identifying the spots called by Schröter *Lexell* and *J. J. Cassini*. This is not very wonderful, as the old Hanoverian has clearly placed them *in the next quadrant*, on the other side of the First Meridian! We shall revert to this matter in its proper place, remarking only at present that the harmonizing and rectification of the existing drawings of the N. circumpolar region would be a task of considerable difficulty.

Very near the Pole lies *Scoresby* (our No. 7), a ring of considerable depth and reflective power, and one of the best guide-points in this ill-marked district. It has in the interior a crater and two hills, which are very difficult to be perceived; its form changes much of course with the libration, varying from 0·36 of the length to 0·09, when its contour as a crater can no longer be recognized.

The North Pole of the Moon lies in a mountainous district, but on a far less magnificent scale than the one diametrically opposite. The difference between the character of the lunar Arctic and Antarctic regions is plainly seen by the shape of the horns before the first or after the last quarter, the N. being far less broken and irregular. There is no indication whatever of snow. A separate map of this vicinity, very beautifully and minutely executed, with a corresponding description, is given in the *Beiträge* * of Beer and Mädler, from observations taken under a conjunction of circumstances so peculiarly favourable as to be worthy of remark, for the encouragement of those who may have been disheartened by frequent disappointments. 1834, Sept. 17, the moon was on the meridian at 12h. 2m., with a S. latitude of 4° 59′, and was full 9m. afterwards. This remarkable coincidence was further favoured by such clearness and stillness of atmosphere as sometimes cannot be met with for a year together in the climate of Europe. An uneclipsed moon of course cannot be "full," in the proper sense of the word; being always deficient on the side nearest the point of opposition to the sun; and consequently, instead of a circular limb, the N. polar region exhibited shadows enough among its ridges and hollows to bring out their true relief, and enable a drawing to be made. The next night, and three nights at the ensuing Full Moon, proved again so favourable that little had to be added on future occasions. They have indicated the exact site of the Pole in a level between two mountainous ridges, and at the foot of a summit of 9400 feet. These heights deprive it for ever of the direct light of day, but must bestow

* The complete title of this valuable though fragmentary contribution to modern astronomy is, *Beiträge zur physischen Kenntniss der himmlischen Körper im Sonnensysteme*. It contains many original observations on the moon and planets. There is a French edition also, entitled *Fragmens sur les Corps Célestes*.

upon it a faint illumination reflected from their own crests, on which the sun never ceases to shine. From this region the centre of the earth is never seen higher than 7°, and the sun rises only to $1\frac{1}{2}°$ above the lunar horizon.

Mare Frigoris (W. half).—This on our map is the portion of the shading lettered B, extending from the first meridian (which of course stretches between the letters N and S) towards the W. as far as Nos. 4 and 5. (It should be observed, by the way, that the shading on the map is not intended to represent the precise form of the plain, which is very indefinitely bounded, but merely to indicate its general position.) It is a grey level of a feeble yellowish or greenish-yellow grey, and looks often exactly like a strip of cloud lying across the moon. It contains nothing very remarkable. The *Lacus Mortis* is a continuation of it between Nos. 5 and 17. This flat incloses towards its middle a tolerably conspicuous and deep crater named *Bürg*, with a central mountain. Its depth as measured is about 6800 feet.

The *Lacus Somniorum* (C in our map) continues this level landscape, but with many irregularities, as far to the S. as the border of the *Mare Serenitatis* (E), from which it differs by being much less flat and even, as is evident when they are both intersected by the terminator at the same time. "If the supposition," say B. and M., "of a watery covering on the moon were admissible, the *Mare Serenitatis* might have been compared to a deep sea, diversified by islands and insular chains; the *Lacus Somniorum*, on the contrary, to a shallow expanse of water, which allows the irregularities of the bottom to appear through it."

Our guides now carry us across to the range of mountains called *Taurus* (the centre of which is marked 8 on our map). This is an extensive region, bounded by the *Mare Serenitatis* on the E., the *Lacus Somniorum* on the N.E., the *Mare Tranquillitatis* (D) and its subdivision the *Palus Somnii* on the S., and on the W. by the range of large craters extending northwards from the *Mare Crisium*. It readily divides into one great mass to the N. and two inferior groups to the S. and S.W.—the first containing the craters *Römer* and *Posidonius* (9, 10); the second a crater called *Vitruvius;* the third, the craters *Macrobius* (11) and *Proclus* (12). The mountains are for the most part arranged in labyrinthine masses, intermingled with plains and valleys.

Römer (9) is a ring-mountain with a very broad and terraced wall. Its depth is computed to be 11,500 feet (Schröter gave 8600), with a breadth of about 25 miles; and its interior contains a mountain (5000 feet high according to Schröter), and a bright crater. To the N. of *Römer*, Lohrmann, upon

whose Section III. we have now entered, represents some elevated masses much more steep and lofty than any which could be identified by B. and M., the landscape appearing to them, though mountainous, yet much more open. On its E. side we meet with a curious bay, named *Le Monnier,* forming one of the darkest portions of the *Mare Serenitatis,* and bounded by a semicircle of steep and lofty cliffs— the half, to all appearance, of a great ring. Of the other half, B. and M. could find no trace; they did not consider an insulated hill, lying out "at sea," though in the right direction, any portion of it, its height (3100 feet) being far inferior to that of the cliffs, which rise in two places to upwards of 8000 feet, and the faintly distinguishable ridges connected with it taking wrong directions. It must be noted, however, that these are otherwise drawn by Lohrmann, and that two of them, according to his figure, very fairly complete the circle. Minutiæ of this kind must be attended to by those who desire to throw light upon the origin of the lunar formations. Although we are unable to detect the existence of any "degrading" influence upon the surface of the Moon, or to comprehend how its masses once erupted—if such were their mode of creation—could, in the absence of air and water, suffer any change excepting what might result from slipping or earthquakes (the reader will pardon the solecism), yet it cannot be denied that in many places there are indications of subsequent alteration which it is more easy to perceive than to explain. Sometimes we might probably incline to the idea that the appearance was deceptive, and must be referred to other causes; but those again are sufficiently obscure. The question is a curious and interesting one, but requires to be approached with much caution; we find from the example of geologists that even a personal examination of the lunar strata might not exempt us from considerable perplexity. We have already met in the *M. Crisium* with instances which would fall within its range (INTELLECTUAL OBSERVER, April, 1864, pp. 204, 205) and shall have to notice many hereafter. *Le Monnier* is easily recognized under all circumstances of illumination, reminding us in this respect, as well as in its general character, of its gigantic counterpart, the *Sinus Iridum* (K in our map) to be described at a future time.

A little N. of *Le Monnier* we come to *Posidonius* (10), a ring-plain of considerable importance, about sixty-two miles in diameter,* remarkable for the defined outline of its wall, which is, however, of no especial height.† A long curved ridge

* Lohrmann gives nearly seventy-four miles: Schröter, about sixty-nine.

† An evident mistake, probably a misprint, in the text of B. and M., prevents their measures from being available. Schröter gives about 3000 feet to three of its peaks on the E. side, above the *M. Serenitatis.*

branches off from the S.W. part of the wall, and runs along the W. side of the interior, leaving a very narrow, but gradually widening trench between itself and the main wall, and vanishing in a most minute point: it is less conspicuous for height, not exceeding 1400 feet, than for sharpness of contour. Schröter has not represented it very well. The interior is but slightly uneven: it contains a small but deep crater, *Posidonius* A, the definition of which, as of most of the objects connected with this great ring, is peculiarly clear. It is more remarkable in another point of view. 1791, November 1, Schröter saw and represented it as a pretty flat depression or ring-plain, its interior being merely grey, without any dark shadow, while seven other small craters in the immediate vicinity had a very obvious black shade within. On referring to a previous drawing, made 1788, August 19, he found that he had then seen it as an ordinary crater, and so it appeared on the following evening (1791, November 2), as a pretty deep hollow with a black shadow like its neighbours, although of course under a considerably greater angle of illumination than twenty-four hours before. Hence he concluded that on November 1, the shadow, which must have not merely existed but been more extensive, had been concealed by the intervention of something giving the crater a grey aspect; and this again would infer the presence of a lunar atmosphere, however subtle and limited in depth. The valley of Lilienthal in which he lived would present, he thought, a similar aspect, if similarly viewed, when during the month of June the moors were set on fire for agricultural purposes. As an analogous indication he remarks that the careful observer will often perceive, in localities in the Moon where mountains have never been noticed, something like very flat hillocks that seem to come into existence under the eye, and again disappear: and if they should be caught up on future occasions, are always found in some altered form. Some such minute variations he noted in the interior level of *Posidonius*, and thought it possible that they might be connected with the assembled habitations of intelligent beings, "who there, as well as we here, praise the goodness and wisdom of their Maker: at least this hypothetical supposition is not unworthy of the greatness of the Creator of the universe; and appearances which vary in such manifold ways admit of being very well reconciled with it."* Such changes, however, he admits, might be equally referred to clouds, or rather their analogues. And if so,

* It is worthy of note that Herschel I. in his early days, when alone he seems to have paid attention to the moon, expressed his conviction as to "the great probability, not to say almost absolute certainty, of her being inhabited." This impression appears, however, to have been merely the result of her general aspect.

Gruithuisen would fully confirm the idea from his own observations, in which they held a prominent place. But whatever may be our opinion as to these points, which, if demonstrable at all, certainly require more rigorous demonstration, there can be no question that the phenomenon described by Schröter was deserving of attention. It was quite safe from neglect in his hands; he measured the depth of the little crater on two occasions, and made it 3774 and 3504 feet, the correspondence showing clearly that there could be no very material error, with a height of 2070 feet for the ring above the external level; a relative amount agreeing well with the usual proportion on the moon, and showing that there is no improbability in the supposition that the rings are the result of actual eruption. He found also on another occasion (1791, Dec. 30) the interior shadow much too trifling in proportion to its distance from the terminator, so as to give the appearance of great shallowness; but in no subsequent observation with any of his telescopes was the greyness which at first struck him to be found again. Lohrmann takes no notice of Schröter's statement, which is given in great detail: B. and M., as an exceptional case, have cited some part of it, and are disposed to admit its correctness; but they have added so much in the way of disparaging remark that it is obvious what was their real estimate of their predecessor's labours. It must be admitted that to a certain extent they were right, and that many of Schröter's supposed changes may be otherwise explained; but we shall hereafter find sufficient evidence that they would have better consulted their own reputation if they had abstained from censuring his prejudices till they had at least in some places equalled the general faithfulness of his comparatively rude delineations. Schröter has recorded many other minute variations in the aspect of the interior level and the wall, which need not be referred to further than as indicating the desirableness of a more accurate study of similar details, for which this great ring seems conveniently situated. I regret to add that I have given but little attention to it, partly perhaps in consequence of its comparative want of elevation, which renders it a less conspicuous object than might have been expected at a moderate distance from the terminator. There are, however, two unusually deep craters on the N.W. side of the ring, whose shadows, if they were of greater breadth, would catch the eye strongly. The larger, or exterior one, which is marked *h* by Schröter, was twice measured by him at 9223 and 10,358 feet—a sufficient evidence, at any rate, of its enormous depth; the corresponding measures of his *i*, which is the smaller, are 9543 and 10,976 feet; fully justifying his remark, "What an extraordinary romantic prospect would not these two craters

exhibit to the human eye, if it could look down beneath it from the inner slope of their rings into such deep basins shaped by nature, and could see the day break in these natural mountain cauldrons, that in point of depth could receive our St. Gothard into them." These measurements are accepted by Lohrmann, but B. and M. do not even allude to this extraordinary depth, and have only thought the inner of the two craters worthy of a letter of reference (B).

This great ring-plain, and its subordinate members, afford an instructive instance of two leading facts pointed out by Schröter, and exemplified more or less in every part of the moon, that the lesser are in general the more recent eruptions, and that the smaller craters, when not actually deeper than their larger neighbours, as is frequently the case, are almost universally so in proportion to their aperture. These evident workings of general laws require the especial attention of every student who wishes to investigate the early history of the moon.

It is somewhat singular that Lohrmann has assigned a brightness of 9° (the maximum being 10°) to our central crater, *Posidonius* A, which B. and M. rate only as 6° to 7°. Had the observers not been nearly contemporary, we might have supposed some alteration in reflective power. B. and M. speak of two other points as reaching 7°, and therefore by inference exceeding A in brightness; the one, the deep crater B in the N.W. ring; the other, a summit on the ring where it abuts upon the adjacent smaller ring-plain *Posidonius* F, on its S.W. side. So little is really known respecting what may be called the *local colouring* of the lunar surface that landmarks of this kind are deserving of record and re-examination from time to time, and we are not without some reason, as will be seen hereafter, for believing that a careful investigation of this subject might meet with its reward.

The cavity *Posidonius* F, just mentioned, is distinguished by a minute crater in its centre; a position much more frequently occupied by a solitary peak, or group of small hills.

I have observed that Lohrmann has considerably exaggerated the size of a small crater (C in his notation—unlettered by B. and M.), lying at some distance E. from the N. end of *Posidonius*, in the *M. Serenitatis*. Too little care seems to have been in general taken in the delineation of small craters in the same neighbourhood according to their proportional size; it is to be hoped that future contributors to selenography will be more scrupulous as to this point, which only requires a moderate degree of attention, and a little caution not to be misled by any apparent enlargement of the ring near the terminator. It is only by means of carefully proportioned

drawings that we shall be able to ascertain whether any enlargement of existing craters is in progress at the present day. The extensive system of measurement which Mr. Birt has undertaken with so much spirit and energy will be most valuable in this respect.

It is not our intention to enter into speculations as to the origin of the present condition of the lunar surface; some inferences are, indeed, very obvious; still, on the whole sufficient materials have not been collected for any satisfactory generalization. But suggestions are always admissible, and sometimes useful; and it may therefore be remarked that the aspect of the partially-doubled and divergent rampart of *Posidonius* might be thought indicative of the intrusion of semi-fluid matter from beneath into a combination of two craters, one formed excentrically within the other.

OCCULTATIONS.

February 2nd.— σ Arietis, 6 mag., 11h. 57m. to 12h. 46m.—9th, 60 Cancri, 6 mag., 5h. 16m. to 6h. 16m.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

BY G. M. WHIPPLE.

1864.	Reduced to mean of day.		Calculated.			Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9·30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Oct. 1	30·095	53·5	48·6	·85	·420	60·6	46·3	14·3	9, 9, 4	E by N, ESE, E by N.	0·000
" 2	...	...	...	...	...	58·7	47·6	11·1	...	... ...	·020
" 3	30·278	48·6	35·5	·63	·356	53·6	43·3	10·3	3, 1, 2	E, ESE, E by N.	·000
" 4	30·132	47·0	36·8	·70	·337	51·6	42·7	8·9	0, 1, 6	E, E, E by N.	·000
" 5	30·048	50·2	40·2	·71	·376	56·0	41·3	14·7	0, 0, 0	E, E by N, E.	·000
" 6	30·155	51·7	41·3	·70	·395	59·0	36·9	22·1	0, 0, 5	E, E by S, E.	·000
" 7	30·227	52·8	44·3	·74	·410	59·8	42·3	17·5	0, 0, 0	ENE, E, E by N.	·000
" 8	30·214	52·2	44·1	·76	·402	59·9	37·4	22·5	2, 3, 7	E, ENE, E by N.	·000
" 9	...	...	...	...	...	54·7	37·4	17·3	...	... ...	·000
" 10	30·253	50·2	45·2	·84	·376	54·8	45·7	9·1	1, 10, 9	NE by N, NNE, N by E.	·033
" 11	30·324	49·5	42·9	·80	·367	54·8	45·9	8·9	7, 10, 10	N, NW, NW.	·000
" 12	30·249	52·4	42·3	·71	·405	57·7	47·5	10·2	10, 10, 10	NNW, NNW, NW by N.	·000
" 13	30·076	51·4	41·6	·71	·391	55·2	49·5	5·7	10, 10, 10	NW, NW by N, NW.	·000
" 14	30·038	51·5	46·6	·85	·393	56·6	44·1	12·5	10, 9, 10	WNW, NW, N.	·000
" 15	30·117	47·4	38·3	·73	·341	53·5	38·7	14·8	0, 3, 8	NE by N, N, —.	·000
" 16	...	...	...	...	...	56·7	45·2	11·5	...	... ...	·027
" 17	29·664	52·4	50·7	·94	·405	59·1	49·3	9·8	8, 9, 9	SW, SW by W, WSW.	·012
" 18	29·661	53·4	48·9	·86	·419	58·0	48·6	9·4	5, 9, 10	SW by W, W by N, SW by S.	·059
" 19	29·197	60·7	54·6	·82	·535	65·6	45·1	20·5	1, 3, 7	S by E, S, S by E.	·002
" 20	30·366	51·3	46·0	·84	·390	58·1	48·9	9·9	1, 5, 0	SW, SW, W by S.	·021
" 21	29·417	50·0	44·3	·82	·373	56·2	41·4	14·8	9, 10, 9	ESE, ESE, ESE.	·000
" 22	29·057	52·1	49·6	·92	·401	57·5	49·3	8·2	7, 8, 10	ESE, S by E, S by E.	·270
" 23	...	...	...	...	...	54·6	48·7	5·9	...	... ...	·241
" 24	29·379	49·3	40·5	·74	·364	56·5	35·7	20·8	6, 2, 1	—, SW, SW.	·000
" 25	29·457	50·6	47·2	·89	·381	54·6	37·6	17·0	9, 10, 10	ENE, E, ENE.	·000
" 26	29·291	52·1	50·8	·96	·401	55·5	49·0	6·5	10, 10, 10	E by N, NE by N, NE by N.	·000
" 27	29·302	52·8	52·1	·98	·410	56·1	51·9	4·2	10, 10, 10	NW, SW by W, SW.	·551
" 28	29·499	51·1	47·4	·88	·387	57·8	46·1	11·7	10, 3, 5	—, E, NE by E.	·020
" 29	29·702	49·6	46·7	·90	·368	54·0	49·2	4·8	10, 10, 10	ENE, NE by E, NE by E.	·017
" 30	...	...	...	...	...	48·3	46·5	1·8	...	... ...	·004
" 31	30·181	42·9	36·1	·79	·292	48·0	41·0	7·0	7, 2, 0	E by N, E by S, ESE.	·000
Daily Means. }	29·860	51·0	44·7	·81	·388	...	...	11·7	...	...	1·277

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—OCTOBER, 1864.

Day. / Hour.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
A. M. 1	8	10	15	19	17	8	5	6	13	11	10	6	6	5	3	8	17	10	4	24	3	9	15	6	2	10	9	3		11	8	9·4
2	7	9	13	21	18	9	6	5	11	11	10	6	5	2	4	6	13	8	4	25	3	10	14	5	3	3	8	3		12	11	8·8
3	8	11	12	20	17	9	4	4	7	11	10	4	5	3	3	6	15	8	4	26	2	9	19	3	3	6	3	3		13	9	8·6
4	5	11	15	18		4	5	4	5	10	13	5	9	3	3	7	18	9	5	20	3	11	16	3	8	7	6	4		9	7	8·4
5	6	12	15	17		6	4	5	5	8	12	5	6	2	5	5	17	8	6	21	5	17	19	3	6	6	7	1		12	5	8·5
6	7	7	13	18		3	6	5	4	10	8	6	9	2	5	5	17	7	3	22	2	17	18	2	6	9	5	3		13	5	8·2
7	7	10	13	19	118	6	11	3	6	12	10	8	9	4	2	5	13	10	8	18	8	16	17	1	5	8	2	6		13	8	8·9
8	10	13	19	24		8	14	4	11	16	8	7	10	2	1	5	15	8	10	18	10	8	25	1	12	12	2	1		14	10	10·3
9	9	16	28	31		6	15	13	8	8	13	8	10	4	4	9	15	7	10	21	9	9	26	1	12	9	2	2		12	15	11·4
10	9	16	32	34		15	10	25	13	16	11	6	11	3	5	11	15	8	23	24	11	14	30	2	13	11	2	3		11	22	14·0
11	13	30	32	31	33	26	14	28	12	17	13	9	12	6	7	13	17	8	27	22	15	15	28	6	21	14	5		15	15	25	17·6
12	15	32	35	37	32	25	16	25	11	15	9	11	15	9	4	17	15	5	25	25	15	19	26	6	19	12	5		19	16	19	17·8
P. M. 1	16	36	35	40	37	24	22	23	14	15	10	11	23	9	3	18	20	9	29	26	15	19	31	6	17	14	5		18	13	28	19·5
2	21	34	34	39	38	27	23	22	11	15	9	11	12	6	3	19	18	5	28	25	19	19	25	5	18	10	7		20	12	25	18·7
3	20	31	35	42	35	29	22	20	14	12	11	7	11	8	3	15	16	5	28	27	21	20	26	6	18	11	6		21	14	29	18·8
4	17	29	36	37	36	25	20	19	10	13	10	7	11	5	2	18	11	6	21	21	22	18	25	6	20	11	6		21	15	26	17·4
5	15	34	31	30	31	24	18	21	7	10	12	8	11	2	0	20	10	5	22	22	23	23	20	4	17	11	7		18	13	17	16·2
6	14	30	27	27	26	22	15	20	8	6	8	4	7	2	4	17	10	4	17	12	22	22	18	1	20	11	4		15	12	10	13·8
7	9	30	21	25	24	18	17	17	10	6	8	7	5	1	3	18	10	5	16	8	20	21	15	0	18	13	3		17	14	10	12·9
8	10	30	21	25	13	20	14	22	10	5	8	9	4	2	4	17	10	7	17	9	24	18	18	1	18	13	5	322	18	16	12	13·3
9	10	30	18	23	5	18	12	15	7	10	7	6	3	1	6	15	6	4	15	5	21	19	11	1	14	11	9		15	13	8	11·2
10	12	30	17	20	7	20	10	11	8	8	7	7	3	4	6	15	10	4	18	8	18	17	11	1	15	10	6		14	11	12	11·3
11	11	28	24	23	5	16	9	12	8	9	6	4	5	6	7	15	12	5	23	4	19	14	8	2	17	9	4		14	12	11	11·4
12	9	17	20	17	6	8	6	13	9	6	8	7	3	4	8	15	12	1	26	2	10	13	8	2	12	7	6		12	9	9	9·5
Total Daily Movement.	268	536	561	637	498	376	298	342	222	260	231	169	205	95	95	299	332	156	389	435	320	377	469	74	314	238	124	588		305	341	12·8

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1864.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		
			Calculated.								
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9.30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Nov. 1	30·193	44·8	34·1	·69	·312	48·2	39·8	8·4	5, 6, 10	E by S, ENE, ENE.	0·000
„ 2	30·146	43·8	34·0	·71	·301	46·3	41·2	5·1	8, 7, 9	NE, E by N, NE.	·000
„ 3	30·281	45·0	37·9	·78	·314	50·5	37·1	13·4	0, 3, 3	NE, NE, NE by N.	·000
„ 4	30·446	41·4	35·9	·82	·277	50·3	28·4	21·9	0, 0, 0	SW, —, —,	·000
„ 5	30·347	44·0	38·8	·84	·304	50·7	31·0	19·7	10, 7, 6	WSW, N, NE.	·000
„ 6	...	...	...	...	...	47·8	35·4	12·4	...	... ...	·011
„ 7	30·406	34·4	31·5	·90	·217	39·5	31·2	8·3	10, 9, 3	S by W, —, —.	·000
„ 8	30·118	38·6	35·7	·90	·251	45·1	27·1	18·0	10, 10, 10	SW by W, WSW, NNW.	·000
„ 9	30·149	42·3	32·9	·72	·286	46·7	33·5	13·2	5, 10, 10	NE, ENE, NE.	·000
„ 10	30·034	38·4	31·9	·79	·250	...	23·5	...	10, 0, 4	—, ENE, ENE.	·000
„ 11	29·917	34·7	31·4	·89	·219	38·8	27·4	11·4	10, 9, 10	SW, NNE, —.	·000
„ 12	29·786	37·9	34·1	·88	·245	43·0	31·1	11·9	10, 10, 10	ENE, SE by E, SE.	·000
„ 13	...	...	...	...	...	49·6	35·1	14·5	...	... ...	·010
„ 14	28·759	46·4	40·4	·81	·330	51·8	43·0	8·8	0, 4, 1	SW by S, SW by S, SW.	·290
„ 15	28·805	42·7	41·9	·97	·290	47·7	32·9	14·8	10, 9, 10	NE by E, NE, N by E.	·000
„ 16	29·369	44·0	40·4	·88	·304	47·2	37·0	10·2	10, 7, 10	WNW, WNW, W.	·010
„ 17	29·254	48·5	47·6	·97	·354	54·3	31·1	23·2	10, 10, 10	SSE, S by E, SW by S.	·069
„ 18	29·402	49·0	37·6	·67	·361	53·3	45·4	7·9	7, 10, 2	SW, W by S, WSW.	·160
„ 19	29·816	48·0	45·2	·91	·348	52·4	33·8	18·6	10, 9, 10	S by E, S by W, SSE.	·004
„ 20	...	...	...	...	...	53·1	44·2	8·9	...	... ...	·002
„ 21	29·863	43·7	43·0	·97	·300	52·1	36·1	16·0	10, 10, 6	SW, SW by S, S by W.	·013
„ 22	29·543	44·9	40·9	·87	·313	52·1	39·5	12·6	3, 9, 3	—, W by N, W.	·245
„ 23	29·610	42·7	39·4	·89	·290	46·2	36·3	9·9	7, 10, 10	S by W, S, SE by S.	·022
„ 24	29·253	38·3	35·3	·90	·249	40·7	35·0	5·7	10, 10, 10	W, SW, SSW.	·909
„ 25	29·303	40·3	35·4	·84	·267	45·7	25·1	20·6	9, 1, 10	SW, SSE, S.	·000
„ 26	29·090	40·6	34·4	·80	·270	45·0	26·4	18·6	3, 4, 3	WSW, WSW, W by S.	·140
„ 27	...	...	...	...	...	52·9	34·6	18·3	...	... ...	·004
„ 28	29·739	50·3	45·0	·83	·377	53·9	34·6	19·3	10, 10, 9	SSW, SW by S, SW by W.	·010
„ 29	30·364	40·4	36·5	·87	·268	46·9	34·6	12·3	0, 1, 0	SW, SW by S, S by E.	·032
„ 30	30·123	45·8	38·3	·77	·323	48·5	36·8	11·7	9, 10, 10	SW by S, S by W, SSW.	·007
Daily Means.	29·774	42·7	37·7	·84	·293	...	...	13·6	...	... ...	1·938

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—NOVEMBER, 1864.

Day. / Hour.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Hourly Means.
A.M. 1	11	13	7	1	4	10	5	4	3	4	5	9	8		2		1		7	17	2	16	11	15	3	15	9	15	8	7	7·9
2	12	12	10	4	3	6	5	2	5	2	2	10	7		4		2		6	14	2	10	10	19	2	15	9	16	5	3	7·3
3	11	14	11	1	3	9	5	2	11	3	3	6	5		5		2		4	12	2	8	9	14	5	12	8	17	8	10	7·4
4	11	13	13	4	3	11	5	1	11	1	1	1	5		2		4		4	12	2	5	6	13	2	13	10	16	6	12	7·0
5	6	13	11	1	5	11	3	1	6	1	1	2	6		2		5	608	3	10	2	10	5	17	2	14	10	16	7	15	6·9
6	7	15	10	1	6	12	2	1	2	3	3	1	6		2		8		2	8	1	10	12	16	1	12	12	18	9	17	7·3
7	10	12	8	3	5	9	1	3	6	1	0	1	8		5		9		3	7	1	8	12	20	0	11	9	11	10	23	7·3
8	11	9	7	2	4	11	2	1	3	3	1	2	10		3		10		3	13	0	11	9	18	1	11	9	20	10	21	7·6
9	14	18	6	4	4	10	2	1	2	2	2	2	15		5		10		2	12	1	8	8	20	0	10	9	24	9	24	8·3
10	23	15	9	4	4	11	3	4	6	1	2	3	13		5		15		8	13	2	10	9	17	2	8	8	24	10	27	9·5
11	28	18	7	3	3	14	2	6	15	2	5	2		22	5	7	21	33	15	15	1	16	8	18	2	12	8	24	10	32	12·2
12	26	19	15	4	7	13	3	2	15	5	2	5		20		7	22	34	13	12	3	14	14	17	5	18	11	27	6	27	13·1
P.M. 1	29	20	12	4	13	20	2	2	10	21	2	4		21		8	21	32	13	10	2	14	10	16	11	15	11	25	7	31	13·8
2	27	20	10	4	14	20	0	2	7	24	2	3		19		8	24	30	14	7	6	9	7	11	12	15	8	26	8	35	13·3
3	21	15	8	4	16	15	0	4	12	16	2	3		17		11	21	25	15	13	10	9	7	10	12	14	7	23	7	30	12·4
4	24	13	6	3	14	15	1	1	9	14	2	2		13		5	22	24	15	10	10	10	6	10	14	15	6	26	6	30	11·6
5	18	13	3	2	9	13	2	3	8	13	1	3		8		6	23	19	15	11	9	15	6	10	21	15	6	24	6	29	11·1
6	17	11	3	1	8	9	1	8	6	10	1	5		7		2	19	18	11	12	7	15	5	10	20	11	10	22	8	29	10·2
7	15	13	3	3	9	8	1	9	8	7	2	5		10		4		15	15	6	10	13	9	7	29	12	9	25	7	31	10·5
8	15	15	2	4	9	10	1	6	9	10	2	4		10		4		12	11	6	12	15	5	6	34	12	10	20	5	23	10·1
9	11	13	2	2	10	8	0	9	6	5	2	6		7		3		13	8	5	12	13	6	5	33	10	16	15	5	11	8·8
10	12	10	2	3	8	7	1	4	2	1	2	5	328	6	202	3		14	16	9	14	14	9	3	28	12	19	11	8	9	8·6
11	13	10	1	5	13	6	2	7	3	4	2	10		5		3		13	17	9	17	14	9	4	21	13	21	10	6	8	9·1
12	14	10	4	2	13	4	2	6	2	4	1	10		5		1		12	17	5	16	11	12	5	15	10	20	12	7	10	8·5
Total Daily Movement.	386	334	170	69	187	262	51	89	167	157	48	104	581		314		1141		237	248	144	278	204	301	275	306	255	467	178	494	10·3

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1864.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2·30 P.M., and 5 P.M. respectively.		
			Calculated.								
Day of Month.	Barometer, corrected to Temp. 32°*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9·30 A.M.
	inches.	°	°		inch.	°	°	°			inches.
Dec. 1	30·168	41·8	39·3	·91	·281	47·3	31·3	16·0	1, 0, 0	SW, SW, SSW.	0·254
„ 2	30·391	35·1	33·8	·96	·222	47·2	26·5	20·7	10, 7, 0	—, —, S.	·000
„ 3	30·334	47·4	44·7	·91	·341	49·6	33·7	15·9	10, 9, 10	S by W, SSW, —.	·010
„ 4	...	...	...	...	...	48·8	44·0	4·8	...	... ...	·008
„ 5	30·046	48·2	36·7	·67	·351	52·8	44·5	8·3	6, 0, 0	SW, S by W, S.	·000
„ 6	30·003	47·3	45·6	·94	·340	51·2	42·9	8·3	9, 6, 2	SW, W by S, SW.	·000
„ 7	29·864	46·7	44·6	·93	·333	48·7	35·0	13·7	10, 10, 10	S, S by W, SSW.	·004
„ 8	29·657	43·7	41·1	·91	·300	46·7	44·9	1·8	10, 7, 7	SSE, SW, S by W.	·040
„ 9	29·817	44·1	41·4	·91	·305	47·4	27·9	19·5	10, 3, 3	—, S by W, S by E.	·027
„ 10	29·838	39·9	38·1	·94	·263	45·0	38·7	6·3	3, 8, 0	E, SSE, NE.	·010
„ 11	...	..	...	...	...	50·2	30·0	20·2	...	... ...	·008
„ 12	29·496	45·5	42·4	·90	·320	48·6	44·5	4·1	8, 10, 4	SE by S, S by E, SW.	·000
„ 13	29·543	42·8	42·0	·97	·291	46·0	32·9	13·1	10, 10, 10	NE, E by N, E.	·030
„ 14	29·774	40·1	36·5	·88	·265	41·2	37·3	3·9	10, 10, 10	ENE, NE by E, NE.	·003
„ 15	29·742	33·4	28·8	·85	·209	35·1	33·1	2·0	10, 10, 10	NE by E, NE, NE.	·000
„ 16	29·822	32·6	30·0	·91	·203	35·3	33·0	2·3	10, 10, 10	ENE, E by N, ENE.	·000
„ 17	29·814	28·2	23·1	·83	·174	31·0	27·0	4·0	10, 8, 10	NE, NE by E, N.	·000
„ 18	...	...	...	...	...	37·1	16·3	20·8	...	... ...	†·025
„ 19	29·924	36·9	33·7	·89	·237	44·4	26·1	18·3	4, 6, 10	—, SE by E, SE.	†·026
„ 20	29·848	44·0	42·4	·94	·304	47·7	30·4	17·3	10, 6, 10	SE, E by S, E by N.	·033
„ 21	29·969	39·1	36·0	·90	·256	40·7	39·1	1·6	10, 10, 10	WSW, SW by W, NW.	·010
„ 22	30·204	33·9	29·6	·86	·213	35·8	35·0	0·8	10, 10, 10	ENE, NNE, NE.	·000
„ 23	30·430	31·7	26·8	·84	·197	33·2	30·5	2·7	9, 10, 10	E, ENE, ENE.	·000
„ 24	30·555	30·7	26·8	·87	·190	33·1	26·6	6·5	9, 10, 10	NE by E, NE, NE by N.	·000
„ 25	...	...	...	...	...	34·3	30·3	4·0	...	... ...	·000
„ 26	...	...	...	...	...	37·1	32·4	4·7	...	... ...	·000
„ 27	30·309	32·5	26·7	·81	·203	35·7	27·8	7·9	1, 9, 10	NW, —, NNW.	·000
„ 28	30·341	38·1	34·0	·87	·247	42·6	28·8	13·8	3, 7, 10	SW, W, W by S.	·000
„ 29	30·329	40·8	36·5	·86	·271	42·7	32·1	10·6	10, 10, 10	NW by N, SW, SW.	·000
„ 30	29·941	38·0	34·2	·87	·246	40·0	38·3	1·7	10, 10, 10	SW by S, SW, SW by S.	·000
„ 31	29·824	34·5	31·6	·90	·218	36·9	30·5	6·4	9, 10, 10	NE, ENE, ENE.	·001
Daily Means.	30·000	39·1	35·6	·89	·261	...	...	9·1	...	... ...	0·489

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch. † Rain and melted snow.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—DECEMBER, 1864.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour. 12	7	2	6	20	10	7		20	5	8	1	15	8	15	22	8	8	2	10	15	5	17	25	18	14	17	6	5	2	6	2	10·2
A.M. 1	5	1	6	18	14	7		16	4	6	1	15	9	17	19	12	7	5	6	18	1	15	28	17	14	16	6	3	4	2	3	9·8
2	3	2	9	17	11	10		20	1	9	4	15	8	11	19	13	3	7	5	18	1	15	23	14	12	12	6	4	2	3	1	9·3
3	2	2	6	16	15	9		19	2	7	2	13	12	9	21	6	7	8	4	14	3	18	24	14	16	11	7	4	4	2	7	9·5
4	4	1	9	16	13	10		18	2	8	3	16	13	9	15	9	6	13	5	18	2	20	23	16	16	15	9	2	4	0	7	10·1
5	5	1	10	17	13	9	48	20	2	10	2	14	11	9	20	12	5	20	7	13	3	22	15	15	13	15	7	2	4	1	8	10·2
6	3	3	10	16	9	5		20	1	9	5	15	4	7	21	13	4	11	6	11	3	20	28	22	16	10	9	5	4	1	10	10·0
7	4	1	10	13	11	6		19	1	7	9	17	5	13	21	20	6	10	8	8	4	26	30	22	18	14	7	7	5	1	7	11·0
8	4	2	13	17	14	5		19	1	5	11	17	3	10	16	15	11	8	3	8	4	29	37	25	16	12	6	5	4	4	5	10·9
9	5	2	10	17	13	5		22	1	14	11	14	7	9	19	22	14	16	2	5	4	23	32	20	15	9	4	5	4	5	4	11·1
10	6	1	18	16	13	8		20	0	7	14	20	12	11	19	26	15	17	1	7	6	21	33	21	15	8	3	4	5	8	5	12·0
11	6	2	15	18	15	7		13	1	9	18	20	13	14	17	28	13	14	2	9	7	23	22	22	15	8	3	6	5	10	8	12·1
12	6	3	13	16	15	5		10	1	6	18	18	13	13	14	24	15	7	2	7	11	22	29	21	15	11	2	7	5	9	7	11·5
P.M. 1	6	4	19	20	19	5		8	9	9	20	17	13	12	13	29	9	6	6	7	12	19	29	19	15	9	5	5	8	6	10	12·3
2	5	1	18	18	15	5	103	7	6	6	20	17	13	12	12	26	6	4	6	5	9	18	25	15	11	10	4	5	7	9	8	10·8
3	5	2	15	15	15	3		6	9	5	18	13	10	18	14	26	6	7	3	9	12	19	28	17	12	9	4	7	8	9	10	11·1
4	7	5	20	18	13	5		5	9	4	19	13	9	14	13	26	3	9	5	7	13	21	32	16	12	10	3	3	7	6	9	11·2
5	6	4	15	11	15	3		5	7	4	17	9	10	15	14	25	4	11	7	4	14	20	19	19	11	10	3	5	6	4	12	10·3
6	5	3	18	11	12	4	15	2	5	1	23	5	8	12	12	23	3	11	8	2	24	21	24	20	14	9	1	4	7	6	14	10·6
7	2	2	17	14	10	2	14	4	3	4	19	5	12	19	13	22	5	12	7	6	22	22	23	18	18	11	2	4	7	6	12	10·9
8	3	2	15	16	8	2	12	5	3	3	20	5	10	18	15	15	2	10	8	7	23	31	22	19	16	7	3	2	5	8	11	10·5
9	3	1	20	14	7	1	17	4	7	3	19	3	9	15	12	10	3	9	13	2	21	31	19	17	16	6	4	3	5	4	9	9·9
10	3	5	19	13	14	1	21	3	8	2	25	3	9	11	9	17	1	9	13	1	19	30	20	16	18	6	5	2	3	3	10	10·3
11	2	6	15	12	8	1	20	4	10	3	17	7	12	16	6	12	3	11	14	2	20	30	17	15	14	6	4	4	4	4	9	10·0
12																																
Total Daily Movement.	107	58	326	379	302	125	250	289	98	149	316	306	233	309	376	439	159	237	151	203	243	533	607	438	352	251	113	103	119	117	188	10·6

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

MONTHLY AND ANNUAL MEANS FOR THE YEAR 1864.

Month.	Barometer, corrected to temp. 32.*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Daily Range.	Total Fall of Rain.
	inches.	°	°		inch.	°	inches.
January	30·184	36·8	33·7	·81	·220	9·0	0·957
February ...	29·918	36·4	32·7	·87	·209	9·7	0·729
March.........	29·655	41·2	35·8	·83	·231	13·8	2·640
April	30·057	48·5	37·4	·69	·363	19·2	0·866
May............	29·979	54·0	44·3	·73	·441	20·5	1·579
June	29·930	56·3	45·6	·70	·465	17·2	2·064
July...........	30·000	62·2	48·6	·64	·570	20·7	0·671
August ...	30·053	60·7	45·4	·61	·546	20·7	1·268
September.	29·917	57·1	49·0	·76	·477	15·4	2·500
October ...	29·860	51·0	44·7	·81	·388	11·7	1·277
November.	29·774	42·7	37·7	·84	·293	13·6	1·938
December..	30·000	39·1	35·6	·89	·261	9·1	0·489
Mean	29·944	48·8	40·9	·76	·372	15·0	16·978

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

TABLE SHOWING THE MEAN VELOCITY OF THE WIND FOR EACH HOUR OF THE DAY IN THE DIFFERENT MONTHS OF THE YEAR 1864 (IN MILES PER HOUR).

	A. M.												P. M.												
Hour.	12 to 1	to 2	to 3	to 4	to 5	to 6	to 7	to 8	to 9	to 10	to 11	to 12	to 1	to 2	to 3	to 4	to 5	to 6	to 7	to 8	to 9	to 10	to 11	to 12	Mean.
Jan.	9·6	9·5	9·5	9·7	10·5	10·0	10·4	10·2	9·1	9·6	10·7	11·0	11·5	11·9	11·7	11·3	10·3	9·1	9·4	9·5	8·4	8·9	8·9	8·7	9·9
Feb.	10·5	10·0	10·1	11·3	11·0	10·5	10·8	11·5	11·9	12·0	13·9	14·0	14·5	14·9	14·6	13·4	13·7	11·2	11·0	10·9	10·0	10·3	10·6	9·9	11·7
March ...	10·6	10·2	10·1	10.4	11·3	10·7	10·7	11·6	13·0	14·0	15·7	17·2	18·7	18·1	18·4	17·1	17·1	15·6	14·6	13·6	13·4	12·6	12·8	11·7	13·7
April.	7·6	7·6	6·7	7·1	7·5	7·0	8·2	9·2	10·9	11·1	11·7	12·0	13·5	13·1	13·4	12·8	13·6	11·9	10·6	10·0	9·3	9·1	9·7	7·8	10·0
May	6·3	5·2	4·7	4·8	4·8	4·6	6·8	8·2	9·1	9·5	10·1	11·1	12·2	11·6	11·7	11·9	11·0	10·7	8·6	8·0	6·8	7·0	7 0	7·0	8·8
June......	7·9	7·2	6·9	6·3	7·2	7·5	9·2	10·6	10·6	11·2	11·6	11·9	13·1	12·9	13·4	13·4	13·8	12·9	11·7	10·1	8·8	8·1	9·4	7·4	10·0
July	6·2	6·5	6·3	6·4	6·4	6·6	8·0	9·4	10·1	10·4	12·4	12·7	13·7	14·0	14·1	14·4	14·8	13·2	11·8	10·7	8·8	8·8	8·3	7·0	10·0
August...	5·9	6·1	5·4	5·3	5·4	5·6	6·7	8·0	9·1	10·1	10·5	11·3	11·1	10·9	11·1	11·5	12·2	11·7	10·0	8·9	7·1	7·1	6·8	5·6	8·5
Sept.	7·5	7·6	6·9	6 8	6·7	7·2	7·2	8·6	10·3	11·8	13·0	13·0	13·3	14·0	14·3	13·2	13·2	10·4	8·9	8·9	7·4	7·3	8·3	7·4	9·1
Oct.	9·4	8·8	8.6	8·4	8·5	8·2	8·9	10·3	11·4	14·0	17·6	17·8	19·5	18·7	18·8	17·4	16·2	13·8	12·9	13·3	11·2	11·3	11·4	9·5	12·8
Nov.......	7·9	7·3	7·4	7·0	6·9	7·3	7·3	7·6	8·3	9·5	12·2	13·1	13·8	13·3	12·4	11·6	11·1	10·2	10·5	10·1	8·8	8·6	9·1	8·5	10·3
Dec.	10·0	9·8	9·3	9·5	10·1	10·2	10·0	11·0	10·9	11·1	12·0	12·1	11·5	12·3	10·8	11·1	11·2	10·3	10·6	10·9	10·5	9·9	10·3	10·0	10·6
Mean.....	8·3	8·0	7·7	7·8	8·0	7·9	8·7	9·7	10·4	11·2	12·6	13·1	13·9	13·8	13·7	13·3	13·2	11·7	10·9	10·4	9·2	9·1	9·4	8·4	10·4

THE "POPULAR MICROSCOPE."

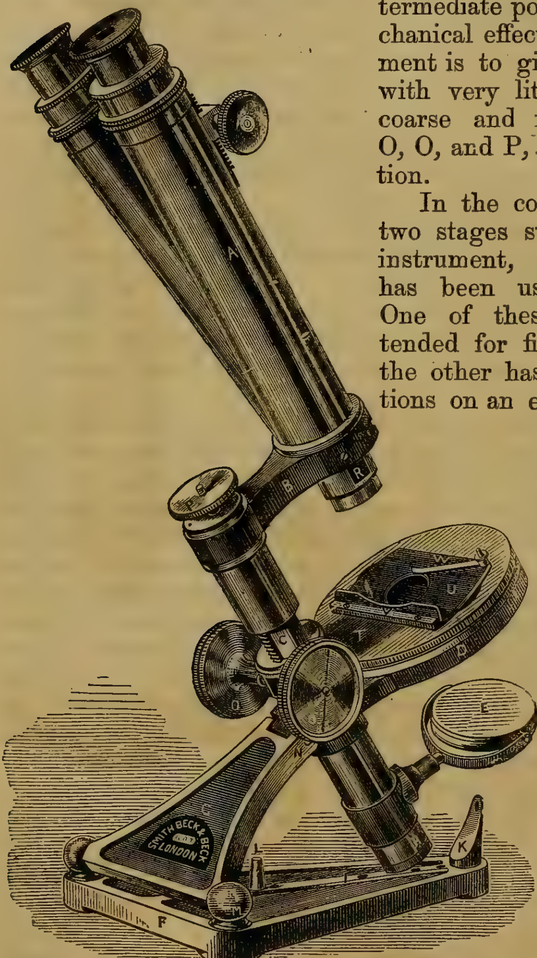
Under this title, Messrs. Smith, Beck, and Beck have introduced an instrument exhibiting more useful novelties in construction than have appeared in any other microscope for a long time. In point of rank, the "Popular Microscope" is intended to take its place between the most simple and the most elaborate patterns. It is devised for those who require more than can be obtained in the various instruments now offered for about five pounds, and who from choice or economy wish to stop far short of the large price which the best makers all charge for their first-class work.

We never undertake to offer any opinion on the purely commercial question of which optician offers the most for a given sum of money. Whenever a new microscope appears, we desire to make our readers acquainted with its peculiarities, and we only feel justified in noticing instruments that differ in some important particular from what has been previously produced.

The requirements of the public are so various that they can only be met by the exertions of a variety of manufacturers directed in somewhat different ways. One microscopist will have a handsome-looking instrument at a low price, and he must be contented with inferiority in the optical work; another will put up with an ugly and even awkward stand, if better glasses accompany it; a third wishes for glasses that divide into lower powers on account of their economy, and he must be content to have less perfection than can be obtained by the purchase of objectives made on a different plan. Even when money is plentiful, and the student is willing to give a hundred guineas or more for an instrument, he will still find that whichever pattern he chooses, he goes without some advantage that another pattern may possess. It is only just to various makers that these facts should be insisted upon, and it is for our readers to form their own opinion of the extent to which the changes introduced by Messrs. Smith, Beck, and Beck are likely to meet their own peculiar requirements.

The first thing that strikes an observer of the "Popular Microscope" is the new mode of adjusting it to any angle between a horizontal and a perpendicular position. On reference to the annexed sketch, it will be seen that the base is a triangular frame, down the middle of which are four holes, a pin L, and an upright K having a hole, shown by the dark spot at the top. The tube carrying the body of the instrument is attached by a pivot to a broad stay, G, and the bottom of this stay is hinged on to the base, F. At the

bottom of the tube H is a pin that fits into any of the holes in the base. If this pin is inserted into the hole near L, the instrument is held upright or vertical. If into the hole at the top of the little support, K, it is horizontal, as shown in Figure 2.* The other holes permit it to be adjusted in intermediate positions. The mechanical effect of this arrangement is to give great stability with very little weight. The coarse and fine adjustments, O, O, and P, need no explanation.



In the construction of the two stages supplied with this instrument, much ingenuity has been usefully exercised. One of these stages is intended for finger movements, the other has mechanical motions on an entirely new plan. Both stages are circular. They fit on to a short stout piece of tube, and can be rotated with slight pressure. It appears to us that this plan, with mechanical arrangements for rotation, might be adapted with advantage to first-class instruments. It is compatible (as in the Popular Microscope) with a thin stage and a large central aperture, facilitating the use of oblique light. The object-holder is attached to the under surface of the stage by a simple circular spring, and holds it down with a force that is easily regulated by two screws. By this means the pleasant smooth resistance afforded by the magnetic stage

* The page containing Fig. 2 must be turned sideways, to bring the figure right.

is obtained without the uncertainty that is inseparable from the magnetic pattern.

The mechanical stage is quite new and very simple. It has the usual quick movements, and the slow ones are regulated by two milled heads working on concentric spindles, as in Powell and Lealand's pattern. One of these spindles has a friction hold upon a plate, which it carries up or down, while the second spindle pulls the first backwards or forwards horizontally, and the moveable plate is so attached as to go with it. This again is an arrangement that looks likely to work well with first-class instruments. It is simpler than the ordinary plan, and does not add so much to the thickness of the stage.

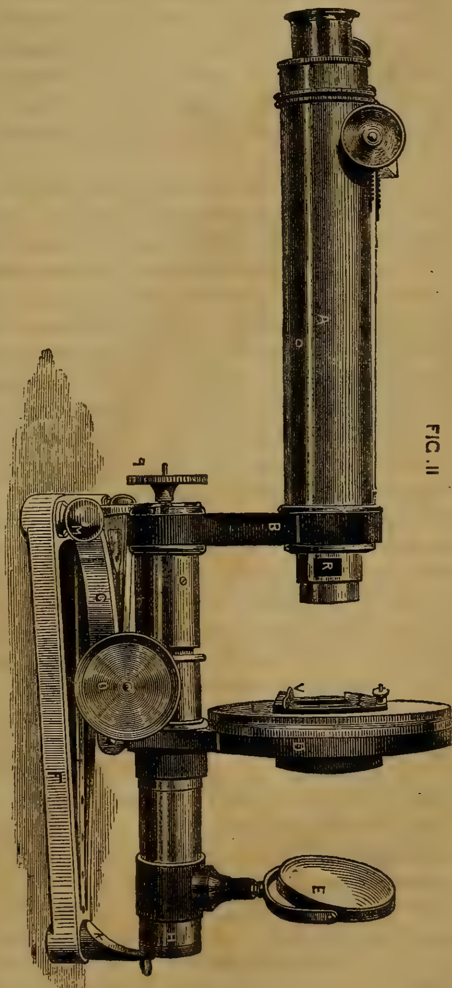


FIG. 11

The "Popular Microscope" is fitted to carry most of the apparatus that advanced students will require, and a set of small angled, but fairly corrected, objectives are made expressly for it. The makers observe that "there are many persons who would not with ordinary objects, and using only the first and second eye-pieces, see any difference between these powers and the very best." They add that, "with very severe tests, and employing the third or higher eye-pieces, the difference is very perceptible; but many who work with the microscope never require the highest class of performance." Small angled glasses are well

adapted for binocular use, and as the "Popular Microscope" has the universal screw, it will carry any of the more expensive and first-class objectives that might be desired.

The microscope before us is supplied with a single combination focussing rather more than three inches from the object, and taking in an object more than three-eighths of an inch diameter. This is a very useful power, and the lowest we have seen of achromatic make. Then there is a good inch, and a good quarter, the latter working very fairly with the binocular, which is seldom the case with low-priced glasses of that focus.

We tried this quarter on our own instrument, using an achromatic condenser with stops. With our third eye-piece, bringing the magnification to about 600 linear, we obtained a distinct resolution of the *Pleurosigma angulatum* into dots. Of course the defects of the glass were shown, as Messrs. Smith and Beck state; but we were surprised to find a low-priced objective of only 75° aperture do so much. A similar trial with the Podura scale was equally effective. There was more colour than when a first-class quarter is employed, but the definition was correct, showing even the spots of light on the wedge-shaped markings. We notice that an achromatic condenser is supplied with the Popular Microscope, but it is not of much use, for want of stops. Two stops would be quite sufficient, and would only add a few shillings to the expense; one should exclude the central, and the other the marginal rays. The plurality of stops in expensive condensers is certainly very valuable for special niceties; but the great majority of work can be done with two, one adapted to show such lined objects as the *angulatum*, and the other fitted for the general examination of objects in which penetration is needed, and the marginal rays are better shut out.

The public are now able to buy microscopes at a great variety of prices and various proportionable degrees of merit. They should be cautioned on the one hand not to expect impossibilities, or fancy that anybody will give them a hundred guinea instrument for twenty pounds; and on the other they should be guarded against a tendency, prevalent in some quarters, to undervalue instruments that are substantially good, though not the *best*. Nine-tenths of the most important discoveries have been made with objectives much worse than those which respectable opticians now supply as avowedly second-rate; and it is only after long practice, and when a large amount of information has been acquired, that the finest glasses became more useful to students than those which, being only a little below them in quality, can be had for half the price.

The workmanship of the Popular Microscope is excellent. Messrs. Smith, Beck, and Beck have wisely determined that their lower priced instruments shall not be stinted in *quality* of work, and we have no doubt the public will approve of this decision.

ARCHÆOLOGIA.

We have in our hands the newly published *livraison*, vol. vi., part 2, of Mr. Roach Smith's *Collectanea Antiqua*, a series of etchings of ancient remains, illustrative of the habits, customs, and history of past ages, and, we may add, accompanied by extremely valuable essays on the objects represented in the plates. This interesting work is, unfortunately, almost inaccessible to the general reader. It appears only at intervals, and is not printed for public sale, but exclusively for a small number of subscribers, so that it becomes immediately after its publication a rare book. A set from the commencement, when it does accidentally occur for sale, is eagerly purchased for a very large price. This is the more to be regretted, as Mr. Roach Smith's *Collectanea Antiqua* is, we have no hesitation in saying, the most valuable collection of antiquarian essays and antiquarian information in existence. To those who are favoured with the possession of it, each new number brings a really rich contribution of archæological facts, as may well be expected from the long experience and activity of its author; and the present number is very far from being an exception, for it contains several papers of unusual interest. In one of these Mr. Smith has brought together accounts of researches made recently among Anglo-Saxon cemeteries, in five different localities—Faversham and Sarre, in Kent; Chessell Down, in the Isle of Wight; Barrington, in Cambridgeshire; and Kempston, near Bedford. These cemeteries were nearly all discovered by mere accident. That at Faversham lay in the line of cutting for the London, Chatham, and Dover Railway, and the numerous and very remarkable objects found in it are now in the possession of W. Gibbs, Esq., of that place. That at Barrington was brought to light during the process of land drainage, and that at Kempston was dug into in the course of digging a gravel-pit. They belong to at least two different branches of the Anglo-Saxon family, for the cemeteries at Barrington and Kempston were, of course, Anglian burial places, while those found in Kent belonged to the Jutes, who, according to the early Anglo-Saxon historians, formed the population of that part of England. The difference in form and design of the principal personal ornaments found in these different sets of graves seems to show that each branch of the race—Angles, or Jutes, or Saxons—wore a distinctive costume, at least during the earlier period of their history, so that the nationality of the individual would be at once apparent by his dress. This is only

one among many particulars in which the objects found in these cemeteries throw light upon the obscurities of the early history of our fathers, and as they are further excavated, the light will become continually greater as the multitude of facts for comparison increases. The objects found in the Isle of Wight bear so close a resemblance to those found in the Kentish graves, that we cannot but consider them as confirming the statement of Bede, though it has been contradicted by some antiquaries, that that island was inhabited by the same Jutish race who formed the population of Kent.

One of the rather numerous plates of Anglo-Saxon antiquities here given by Mr. Roach Smith represents the contents of a grave in the Isle of Wight, just as they lay when discovered. It was that of a lady, who, in life, had evidently been "of stately presence." Round her neck had been hung a rather long string of beads, varied in form and design, and many of them very beautiful. She appears to have worn a robe, which was fastened at the breast by three large fibulæ of silver (of a form which is found commonly, though of different material, among the Anglian graves), arranged one above the other. Over the robe a mantle appears to have been worn, probably open in front, for it had been fastened at the right shoulder by a fine large round fibula, and on the left shoulder by a fibula of a different shape, but equally ornamental. At the waist a buckle indicated the place of the girdle, and near it lay a knife, which had, perhaps, been placed in a case attached to the girdle. Between the legs were two objects which appeared also to have been suspended to the girdle, and probably hung rather lower than the knees. One of these objects was a large spoon of silver gilt, the bowl of which was perforated with five holes; the other was a ball of dark-coloured crystal, enclosed in silver mountings. The use of either of these articles is not very evident. There are some reasons for believing that in these early times a ball of crystal attached in any way to the person was looked upon as a sign of authority or power, but Mr. Smith seems inclined to reject this interpretation. At the lady's feet had been deposited a bronze pail and two buckets. The little finger of her right hand wore a massive gold ring, beautifully chased, and on the same finger of the other hand there was a spiral ring of silver. Close to the left arm, and parallel to it, lay a key-shaped object made of iron; and in a similar position on the other side of the body another implement of the same metal, formed like a sword, but quite blunt at the edges, and narrowing off into a long point at the end. The handle was close by, and perhaps in, the hand. A cloth fringed with gold tissue had been thrown over the head and face. Altogether, the costume must have been very rich and handsome.

Another excellent paper in this number of the *Collectanea Antiqua* is devoted to the subject of "Remains of Roman Potteries on the banks of the Medway and the Nen, and in London." In an essay on the "Archæology of Horticulture," continued from the previous number, Mr. Roach Smith has collected a far larger quantity of evidence, much of it extremely curious, on the cultivation of the grape for wine in our island, and has shown most satisfactorily

that in former times wine was commonly made in England. The subjects of the other papers are all Roman. There was a town in ancient Egypt named Babylon, which is pretended to have been founded by Babylonian captives, but it was fortified by the Romans, and made the head-quarters of one of the legions. It became in the middle ages the capital of the Egyptian khalifs, and a place of great commercial importance, and has been sometimes confounded with the more celebrated Babylon in Assyria. Its site is commonly called Old Cairo, and is remarkable for the fine remains of Roman building which are still seen there. These are here represented in some spirited etchings by Mr. Fairholt, from drawings made by him on a recent visit. Another paper describes the Roman villa recently discovered at Carisbrooke, in the Isle of Wight, with views and plans, and an engraving of the very elegant tesselated pavement which formed the floor of one of the rooms; and in another, Mr. Roach Smith has brought before the notice of antiquaries a new class of antiquities, Roman leaden seals, which have been found in rather considerable quantities on the site of the Roman *Verteræ*, at Brough-upon-Stanmore, in Westmoreland. If found elsewhere, they are excessively rare, and it is very difficult to say what was their particular use, except that they have many of them holes which were evidently designed for attaching them to some object which they were intended to authenticate. Perhaps there may have been here an official depôt for such objects, where th seals were taken off. Many of them have inscriptions, some containing the name and number of a military legion or cohort, and others apparently the names of individuals. Some of them have figures resembling those found on coins and gems. The only contribution to our archæological knowledge in this number of the *Collectanea* which remains to be noticed, consists of two plates of rare coins of the Emperor Carausius, which are supplementary to an article on the same subject given in a preceding volume. We need hardly point out the great interest the coins of this usurper have for the history of Roman Britain.

The excavations at Silchester, on the site of the Roman city of *Calleva*, carried on at the expense of the Duke of Wellington, the lord of the soil, have not, as far as our last information goes, produced any very interesting results, beyond the discovery of the foundations of houses and floors. The latter, though belonging to rather large rooms, appear, as far as they have been hitherto uncovered, to have belonged to houses of a class not very highly decorated. The greater number were paved merely with the common red tessellæ, but in some the pavement was formed of white and red tessellæ alternately, and one only had a richer tesselated pavement, with a central ornament, which had been nearly destroyed at some former period, radiating from which were found portions of white tessellæ, forming a stellated pattern. The coins found are few, and only of common types, including examples of Gratian, Constantine, Allectus, and Carausius.

Interesting discoveries have recently been made on the site of a Roman settlement at Southfleet, in Kent, supposed to belong to

the town of *Vagniacæ*, marked in the Roman itineraries as lying on the great Watling Street road somewhere in this neighbourhood. Frequent discoveries of Roman remains have been made at this place during many years, which tend to show that it must have been a town of considerable importance. Various objects lately found there were exhibited at a recent meeting of the Archæological Institute, including a richly jewelled necklace of gold, with rings and bracelets of the same material, found in a stone coffin with the skeletons of two young children; and two previously unknown British coins in bronze, one of which bears the figure of an elephant. We may remark that the discovery of British coins under such circumstances is not necessarily a proof of the early date of the settlement, as British and Gaulish coins were certainly in circulation during a considerable part of theRoman period.

An interesting discovery has been made at Northwich, in Cheshire, where the Romans had considerable salt-works. While excavating for graving docks on the banks of the river Weaver, the workmen came upon four leaden pans, which had been used by the Romans for extracting brine from the natural salt. They were found at a depth of about ten feet. The workmen broke up three of these vessels and sold them for old metal, but the fourth was preserved, and is now in the Warrington Museum. It is a square vessel, about three feet and a half long by two feet and a quarter wide, and four and a half inches deep. At each end there is a hole in the side, believed to have been intended for the purpose of fixing it to a wooden framework, and the inner surface of the bottom is covered with scratches, supposed to have been made by the teeth of a rake, used for removing the dross deposited in the process of evaporation. On one side there are marks of letters, which have not been satisfactorily deciphered. On a fragment of one of the other pans an inscription has been traced which seems to be correctly read as DEVAE, which was the Roman name for Chester, and has been conjectured to mean that the Roman salt-works at Northwich belonged to that city. But this does not appear to us to be a very probable interpretation. T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

ROYAL SOCIETY.—*Dec.* 15.

On the Production of Sugar in Animals by Cold.—Dr. Bence Jones read a paper detailing the production of sugar in the fluids of the animal body by extreme cold, attributing its formation to deficient oxidation of the carbonaceous articles of food. For example, a grain of starch enters into the body, and is transformed into sugar; it is then acted on by oxygen, and ultimately passes out as carbonic acid and water. This is the final result of the perfect combustion; but if the oxidation stops at any stage, imperfect combustion occurs.

The combustion may be made imperfect in at least three different ways. First, by insufficient oxygen; secondly, by overwhelming fuel; thirdly, by reducing the temperature so low that chemical action is checked. From each of these causes the following scale of the combustion of starch in the body may be formed:—When there is perfect combustion, then carbonic acid and water are produced. With less perfect combustion, oxalic and other vegetable acids are formed. With the least possible combustion, sugar results. Between perfect combustion and the most imperfect combustion—that is, between carbonic acid and sugar—there are probably many steps formed by many different acids; and as in a furnace one portion of the coal may be fully burnt, whilst other portions are passing through much less perfect combustion or are not burnt at all, so different portions of starch may reach different steps in the scale of combustion, and sugar, acetic acid, oxalic acid, carbonic acid, and many other acids between acetic and oxalic acid, may be simultaneously produced. From this account of the oxidation of starch, it follows that sugar should always be found in the urine whenever any of the three causes mentioned reduce the oxidation in the system to its minimum. In other words, by stopping the combustion that occurs in the body, diabetes should be produced artificially.

ETHNOLOGICAL SOCIETY.—*Dec.* 27.

The Hairy Men of Yesso.—A paper descriptive of the hairy people of the Island of Yesso was read by Mr. Martin Wood. Yesso, which is inhabited in the southern portion only by the Japanese, has an infertile soil and dreary climate. Its northern parts are inhabited by the Mosinos, or "all hairy people" of the Japanese, who number about 100,000, and dwell principally in two large cities, Mato-mai and Hako-dadi. These people are short, thick-set, and muscular, but clumsy and uncouth in their movements. In appearance they are wild and repulsive, in consequence

of the enormous amount of hair with which they are covered. The hair on the scalp forms a matted mass of gigantic size, their beards are long and thick, growing from the greater part of the face, and the whole of their bodies is covered with an extraordinary profusion of hair.

The women stain that part of the face which is covered by the beard in males. The skin, when not bronzed by exposure, is somewhat paler in colour than that of the Japanese.

These people, though timid from long subjugation to the Japanese, and isolation from the rest of the world, appear intelligent and lively. They have well-developed prominent foreheads and dark expressive eyes.

Their legends go back to a time previous to their having been subjected by the Japanese, probably several centuries before the Christian era.

ROYAL GEOGRAPHICAL SOCIETY.—*Jan.* 9.

The Ancient Remains near the Sources of the Tigris.—Mr. J. C. Taylor, consul at Diarbekr, described several ancient remains he had discovered near the sources of the Tigris. The most interesting were two Assyrian inscriptions near the principal source of the Tigris. One of these belongs to Tiglath-Pileser I., who reigned about B.C. 1110, and the other to Ashur-izir-pal (the king of the Nimroud monolith), who dates about B.C. 880. The fact that such memorials had been placed in the situation where they had been found, by those monarchs during their northern expeditions, had been ascertained years ago by the reading of inscriptions found at Nineveh; and their discovery by Mr. Taylor is a striking proof of the truth of those interpretations. The main branch of the river, here called Dibeneh Su, is formed by the junction of various small streams, some of these sources being within as short a distance as five miles from other sources which fall the opposite way into the Euphrates. After a course of three miles the principal stream of the Tigris plunges into a lofty cavern, and is lost underground for a distance of two miles, emerging on the south-east, and then continuing its course towards Diarbekr. The numerous masses of rock which now choke the stream near this cavern, and the detached arches, seemed to indicate that the tunnel was formerly of much greater length than it is now. The statement of Strabo with regard to the extremely long underground course of the Tigris near its sources, was therefore, in all probability, not far from the truth.

ROYAL ASTRONOMICAL SOCIETY.—*Jan.* 13.

Mr. Huggins on the Occultation of the Spectrum of a Fixed Star.—The author remarked that while all observations hitherto negative the existence of an atmosphere to the moon, one had occurred to him as not yet made which might add to the evi-

dence on the question. This was the disappearance of the spectrum of a star when occulted by the moon's limb. It appeared to him that if the moon possessed an atmosphere, it should show itself by producing absorption bands, and also by a gradual fading of the spectrum instead of a sudden disappearance. He also thought that, supposing an atmosphere highly charged with aqueous vapour, the red rays would be least affected, and that end of the spectrum would be last to go, while a clear but dense atmosphere would, by refraction, render the blue rays most persistent. He therefore, on the 4th instant, adjusted his spectrum apparatus on the star ϵ Piscium about three minutes before its occultation. He could not speak positively as to any extra lines being introduced by the moon's contact, the air not being in good condition, but certainly no part of the spectrum disappeared before the other, the obscuration occurring not in the direction of the length of the spectrum, but of its breadth, cutting off all the colours at the same time, and not by a process of fading, but as if an opaque screen had been slowly introduced, about two-tenths of a second being occupied in the occultation. This experiment, therefore, further corroborated the general impression of the absence of any appreciable lunar atmosphere.

PROGRESS OF INVENTION.

Application of Compressed Air to Weaving.—Every one that has witnessed the process of weaving, by means of the power-loom, must have remarked the stunning and most disagreeable noise by which it is accompanied. The greater part of this is due to the mechanism used for throwing the shuttle alternately from one side to the other. In the hand-loom, the shuttle was thrown by the hand of the weaver; in the power-loom, invented in 1785, mechanism more or less resembling the weaver's arm was introduced for the purpose. A great velocity was thus obtained, but an intolerable din was produced, and what was far worse, a deterioration of the textile fabric, consequent on the great vibration communicated to the whole room, and on the irregularity of the motion which is imparted to the shuttle. There is a very great loss of power also, in consequence of the force not being applied in the right direction. Besides all this the mechanism which acts on the shuttle is extremely liable to get out of order: the thread is frequently broken: and it is necessary to use large quantities of oil, which, becoming heated by friction, causes a very disagreeable smell and unwholesome atmosphere, and not unfrequently escaping, injures the cloth. But a great change for the better is now very likely to be introduced. Compressed air has recently been adopted as the means of imparting motion to the shuttle, which may then be made very much lighter. The advantages derived from this arrangement are believed by many to be numerous and considerable. As the force is applied exactly in the direction in which it is required, there is a great saving

of power. As there is no vibration, and the shuttle is thrown with mathematical accuracy, the cloth, even when viewed in the microscope, is found to be entirely free from those irregularities and imperfections which in the ordinary kinds are concealed by the dressing. The atmosphere, instead of being heated and corrupted, is cooled and purified by innumerable jets of fresh air. With the ordinary power-loom, the shuttle is thrown only about 180 times in a minute; with the pneumatic arrangement, it is thrown at least 240 times. This increase of velocity, accompanied by the fact that when condensed air is used the thread almost never breaks, will immensely augment the annual production. Supposing that the half million of looms which are in operation in the United Kingdom were on the pneumatic principle, the increase of production would, on a moderate calculation, be at least a million and a half yards per annum. The new loom has a great advantage over the old, as to first cost and the expense arising from wear and tear. No less than thirty-eight parts hitherto indispensable are got rid of, and friction is greatly lessened in various ways. Oil not being required, there is no danger of the cloth being stained. The fibres, which greatly impede the motion of the shuttle in the old loom, are blown away in the new. The movement of the shuttle is effected in a very simple way. Air is condensed into a reservoir by the steam-engine, and conveyed under the floor in pipes, which communicate with flexible tubes that transmit it to each loom; or the loom itself condenses the air it requires by means of a small air-pump, or even a bellows. A pinion on the main axle of the loom causes the revolution of a wheel, upon which is fixed an inclined stud that acts upon a lever which opens a valve. The latter lets out a jet of air that blows the shuttle forward with great velocity and unerring accuracy. Of course there is a separate valve, lever, etc., for each of the directions in which the shuttle is to be thrown. The superiority of the new loom to others previously invented has, however, been denied.

The Musical Clock of St. Germain l'Auxerrois, at Paris.—This is another very interesting application of compressed air to the simplification of mechanism. All who hear for the first time the musical clocks of Bruges, Mechlin, etc., are charmed with them; but when the same piece, however elaborate it may be, is heard again and again, the admiration cools, until at last, to those who are condemned to listen to it, year after year, from infancy to age, it must become little less than an annoyance. Yet when we consider that each tune played by a musical clock requires a barrel or cylinder, which costs a very large sum—that used in the clock at Bruges cost 60,000 francs—we must readily admit that those who for the credit of their city are desirous of having a musical clock, must make up their minds to the endless repetition of the same piece of music. The mechanician charged with the construction of the clock of St. Germain l'Auxerrois, to which forty bells are attached, appears, however, to have removed this difficulty, since he has lowered the price of the barrel from 60,000 to 250 francs, which makes it possible, without great expense, frequently to change the tune.

The means by which he effects this improvement, are very simple. Hitherto the barrel of a musical clock was required to produce powerful mechanical effects—it had to lift the immense hammers that struck the bells, and therefore it was of necessity large and massively constructed; and to move it enormous weights, and complicated as well as ponderous machinery, were indispensable. With the pneumatic arrangement, the barrel merely opens valves similar to those of a moderate-sized organ, and these allow the escape of air, having a pressure of about two and a-half atmospheres, which gives motion to the mechanism that produces the sounds. The barrel may, therefore, be as moderate in size, and the mechanism attached to it as simple, as that of a self-acting organ. The air is condensed by the gas-engine of Lenoir: but there seems no reason why the condensation should not be effected by some of the enormous water-power that will soon be available in all parts of Paris.

Electro-magnetic Locomotive.—A good deal of excitement exists at present in Paris with reference to an electro-magnetic locomotive which is being exhibited there. It rests on four wheels: those in front are small; those behind—the driving-wheels—are large, and made of copper, and contain each twenty horse-shoe electro magnets arranged in the direction of radii, and having their poles passing through the copper tires so as to be level with the outer circumference. The electric current is produced by a battery which is placed at a station, and is conducted to and from the locomotive by two well-insulated wires, running between the rails. A very ingenious commutator distributes it to the electro-magnets, successively magnetizing and demagnetizing them. The instant one of them is excited, it is attracted by the rail itself, which acts as an armature, or keeper, and the wheel is thus made to revolve, moving the locomotive in one direction, or the opposite, as the case may be. In the present arrangement, the electricity passes from an electro-magnet at one side of the locomotive to one at the other, that is, about one quarter of the circumference in advance. To stop the engine, it is of course only necessary to interrupt the current. This locomotive has one great advantage—it cannot leave the rails, or if it does it will stop immediately. But the power is very trifling, and much of it is lost from the indirect mutual action of the magnet and rail; nevertheless the inventors, MM. Louis Bellet and Charles Rouvre, consider that it would be quite sufficient for the transmission of letters and light parcels, and they even expect it ultimately to supersede the ordinary locomotive. They calculate on a velocity of about 124 miles an hour; and their model does actually attain very considerable speed. But supposing such a locomotive to be, even on the large scale, everything that can be expected, it is still very unlikely that it will compete successfully with the ordinary one. Coal will afford about six times as much power as the same weight of zinc, and, weight for weight, is about forty times as cheap. That is, at the present price of zinc, electro-magnetic is about 180 times as dear as steam-power. To get rid of this difficulty, zinc must become very much cheaper, or a cheap substitute for it must be discovered; neither of which appears sufficiently probable to afford

electro-magnetists much ground for sanguine expectations. In cases, however, in which only small power is required, and the cost of its production is but a secondary consideration, while from the intermittent nature of the work to be done, and other circumstances, a steam-engine would be out of the question, electro-magnetism may be applicable. But, considering the complication and cost of any of the electro-magnetic engines yet invented, it is to be feared that the period at which electro-magnetism will be utilized, even to this limited extent, is still distant.

Pointing of Pins and Needles by Electricity.—The pointing of pins and needles is not only a troublesome, but, notwithstanding all the improvements that have been made, an exceedingly unhealthy operation. The fine metallic dust which is produced enters the lungs, and causes disease, which, sooner or later—generally very soon—proves fatal. There is, however, reason to believe that the old and objectionable process will soon be superseded by a new, a simple, and a harmless one. The latter was supposed to have been recently discovered at Lausanne by M. Canderay, a telegraph engineer; but a correspondent of *Les Mondes*, in the number for December 29, shows that he had published an account of the method so long ago as 1860; he admits, however, that its application to the pointing of pins and needles is a happy and recent idea. The pins, etc., to be pointed are placed close together in a bundle. The latter is to be held perpendicularly, and its upper end having been brought in contact with the positive pole of a Bunsen battery consisting of one or two elements, it is to be immersed in acidulated water contained in a vessel, through the bottom of which the negative pole of the battery has been passed up; the lower end of the bundle and the upper end of the negative pole being kept within a very short distance of each other. In a few minutes, the number being greater or less, according to the nature and concentration of the acid, the nature and thickness of the wires, and the intensity of the current, the ends of the wires next to the negative pole of the battery will have been pointed, the sharpness and form of the points depending on the distance between them and the negative pole. One hundred wires have been pointed in this way, in a few minutes, with a Bunsen battery, consisting of but a single element. Hence, from the smallness of the electric power, and the shortness of the time required, the process promises to be very economical. Sulphuric acid answers best for iron or steel; nitric acid for copper or brass. Our readers can easily make an experiment, illustrating this process by immersing the wire constituting the positive pole of a small battery in dilute acid contained in a glass tube, the lower end of which has been closed with a cork, through which the negative pole of the battery has been passed up. The poles are to be kept for a few minutes very near each other within the fluid.

Simplification of the Common Pump.—A modification of the ordinary suction pump, as it is called, has lately been invented and patented in France, which seems, for many purposes at least, to recommend itself strongly by its simplicity, and other good qualities. The common pump consists, as is well known, of a barrel, a piston,

and two valves opening upwards; the pump to which we direct attention, of only a barrel, a solid plunger, and a single valve. The former pump is exposed to great wear and tear, and very considerable friction, from the necessity for the sucker fitting the barrel exactly; the latter is totally free from these objections. Our readers may make an excellent model of the new pump by fitting water-tight into one end of a cylindrical glass gas chimney a piece of wood or cork, in the centre of which is an aperture, closed within the glass cylinder by a flap of leather, which will act as a simple, but tolerably water-tight valve; and selecting for the plunger a thick rod of wood that nearly fills the cylinder. To work the apparatus, it is only necessary to insert the plunger in the cylinder, fill the space around it with water, and place the closed end of the cylinder in a small quantity of that fluid. When the plunger is drawn up, the valve opens, and water rushes in to supply the vacuum. When the plunger is then pushed in again, the water flows out through the upper end of the cylinder: and thus the process may be continued for any length of time. It is evident that the fluid may be made to issue from a spout or tube, if the upper end of the barrel is enlarged. The principle on which this pump produces its effect is the same as that of the common pump, but it might be supposed that, instead of water rushing up through the valve, water, and even air, would pass down from around the plunger. This, however, is not the case; and it is the most curious circumstance connected with the apparatus. It may be accounted for, however, by the capillary attraction which exists between the plunger and barrel. Experiment alone can show how large such a pump may be made, or from what depth it would cause water to ascend; but there are most probably many purposes for which it would answer well.

New Respiratory Diving Apparatus.—*Cosmos* states that M. Rouquayrol has introduced a reservoir of compressed air, furnished with a mechanism (not explained) for allowing the air to escape in the proportion wanted for submarine respiration. Experiments made in the Napoleon Basin at Rochefort have been successful. The apparatus is also recommended to enable persons to enter a deleterious atmosphere.

Crystal Patterns on Glass and Porcelain.—M. Kuhlmann, continuing his communications to the French Academy on crystallization, gives a process which it would be easy to try on a small scale. If, for example, a solution of sulphate of zinc and a little gum is thickened with chromate of lead, and laid on glass, and the glass heated in a muffle, he obtains a crystalline pattern, shown up in relief by a green tint imparted by the chromic oxyde. Nitrate of potash and nitrate of lead, thickened with gum, and containing powder of coloured enamels, he also finds to afford satisfactory results.

Miscellaneous.—Among the recent improvements in telegraphy, one of the most interesting, perhaps, is the *acoustic telegraph*, in which a note sounded at one place is reproduced at another. It is founded on the fact that a sound is emitted whenever a sufficiently strong electric current is made to begin or

to cease to circulate round an electro magnet; and that a stretched membrane will vibrate in unison with a note produced near it. But, since the same membrane will respond only to certain notes, the range of sounds producible by a single apparatus is more or less circumscribed.——It is proposed to apply to practical purposes the enormous *water power* which will soon be available in Paris, in consequence of the vast waterworks now in progress there, and which, when complete, will raise about 400,000,000 litres a day to the level of the highest houses. The large amount of pressure generated by this will be distributed throughout the city, so as to be easily applicable by means of simple machinery at any given point.——*A steam and air engine* has been recently patented. The cylinder used, like that of Watt's single acting steam-engine, is open at one end. Round the part of it which is near the open end are a great number of holes, which, when the piston has passed them, forms a communication between the interior and the atmosphere, and allows the mixture of steam and air after it has done its work, to escape. At the return stroke of the piston air enters in front of it through these apertures, and is driven into a small chamber at the closed end of the cylinder, where, being mixed with high pressure steam admitted by a valve opened at the proper time by the piston itself, its temperature and therefore its pressure are suddenly raised; and along with the expanding steam associated with it, it drives the piston to the open end of the cylinder. The repetition of these movements causes a reciprocating motion, which is changed into a rotatory, in the usual way. Independently of other objections the heat and pressure acquired by the air are detracted from those of the steam, and what is thus gained in one way, may be found to be so much lost in another.——There is reason to believe that *telegraph wires* may be made to serve a useful purpose, not hitherto contemplated: since it is supposed that they will afford a very effective aid in foretelling changes of weather. It has long been remarked that they are liable to considerable variation in the transmission of the electric currents: but it has been recently observed that when these variations are unusually great they are always followed by bad weather, which is stormy in proportion to the greatness of the irregularities exhibited.——The metal *cæsium* has hitherto been obtained only in very small quantities. To get only seven grains of its chloride Bunsen was obliged to evaporate forty tons of water; and only 0·3 per cent. of it are contained in the Lepidolite of Hebron in the United States. But it has recently been found that the mineral Pollux, which is very abundant in the island of Elba, contains thirty-four per cent. of this metal, which had been previously mistaken for potassium.——*Tellurium* also, hitherto one of the rarest of substances, is found in considerable quantity associated with bismuth, about 15,000 feet above the level of the sea, in one of the loftiest peaks of the Andes.——The reduction of chloride of *aluminium* by means of zinc was patented in 1854, but the principle was not successfully carried out until recently. The vapour of zinc is found to reduce cobalt, nickel, and manganese with great facility.——*Cotton seed oil* may be obtained to the amount of

from fifteen to eighteen per cent. from cotton seed, which is very much cheaper than linseed. The residue is nearly as valuable for fattening purposes as linseed cake. The crude oil answers well for paints and varnishes, and makes excellent soap. The refined is considered little inferior to olive oil.——Two facts of great importance in medicine have lately been discovered. One, that in typhus fever, the interior of the mouth is the seat of a putrid matter that constantly poisons the air passing into the lungs, and becomes the haunt of parasites. Several of the worst symptoms that accompany the disease are now supposed to be due to this. It is removed without difficulty, and to the great benefit of the patient, by very simple means. The other is that the application of phenic acid in the dressing of putrid sores not only prevents or removes the offensive odour, and stops disorganization with great rapidity, but leads to a speedy and healthful healing, even in the very worst cases. It is applicable not only externally, but, notwithstanding its caustic properties, internally also; and it appears to be specially useful in cases of an infectious nature.——It has been found that *pencil drawings* may be reproduced in any number, with great facility. For this purpose they are to be moistened with dilute acid, and then inked with a roller. Only the pencil marks will take the ink, and the drawing may then be transferred to metal or stone, in the usual way, by pressure.

NOTES AND MEMORANDA.

Apparent Diameter of Sirius.—Sir Wm. Herschel endeavoured to find the apparent diameter of Sirius as seen in a telescope, and freed from the enlargement due to optical defects. He estimated it at the tenth of a second. M. Chacornac, availing himself of more recent apparatus, views the star through what he calls a "prismatic telescope," and which the secretary of the Astronomical Society supposes to mean "a double-image prismatic micrometer eye-piece." M. Chacornac's letter, which appears in the *Monthly Notices*, does not explain his method with sufficient distinctness. The society's hon. secretary (Mr. Pritchard) points out that in the spurious discs of stars, as seen through telescopes, the light diminishes from the centre to the circumference of the principal image, and varies in a similar manner through the series of rings with which the star image is surrounded. He supposes M. Chacornac to form two images of the spurious disc by means of double refraction, polarized in planes at right angles to each other. When the prisms are rotated, the ordinary image is unaffected, but the extraordinary image suffers gradual extinction, the weaker parts, or margins, being extinguished first, and the centre last. If the star exhibited a true disc in the telescope, it would remain, and be susceptible of measurement after the spurious light surrounding it had been extinguished. When, however, the spurious light is cut off, M. Chacornac found, with Foucault's great telescope, that only an imperceptible point remained, so that the apparent diameter of Sirius, freed from appendages resulting from the intensity of his light, resembled the apparent diameter of a twelfth-magnitude star.

Biela's Comet.—In a communication to the *Astron. Nach.*, Dr. Giacomo Michez expresses a hope that when this body, which revisits us this year, approaches its perihelion in the beginning of 1866, decisive evidence may be obtained concerning the two nuclei which were seen in 1852. In 1859 the feebleness of the comet's light, and its immersion in strong twilight, precluded obser-

vation. We do not publish the positions of the comet between July, 1865, and March, 1866, as given by Dr. Michez, as it will be better to do so at a later period. We may, however, say, for the benefit of distant subscribers, that on July 24 the R.A. will be 0h. 18m. 37s., D. + 18° 40′ S.

EARTHQUAKE AT FLORENCE.—M. P. de Tchihatchef describes to the French Academy an earthquake felt at Florence and its vicinity on the 11th December last. The observations of Prof. Donati show that the centre of the disturbance was at Fierenzuola, a village forty-five kilometres, or rather more than twenty-seven miles from Florence. This convulsion is remarkable, not only because earthquakes are rarely felt at Florence, but because it is the first time volcanic action has been manifested in the limestone (*massif calcaire*) of the Appennines situated north of the city. The occasional concussions previously felt at Florence have come from the Pontifical States, which lie in an opposite direction.

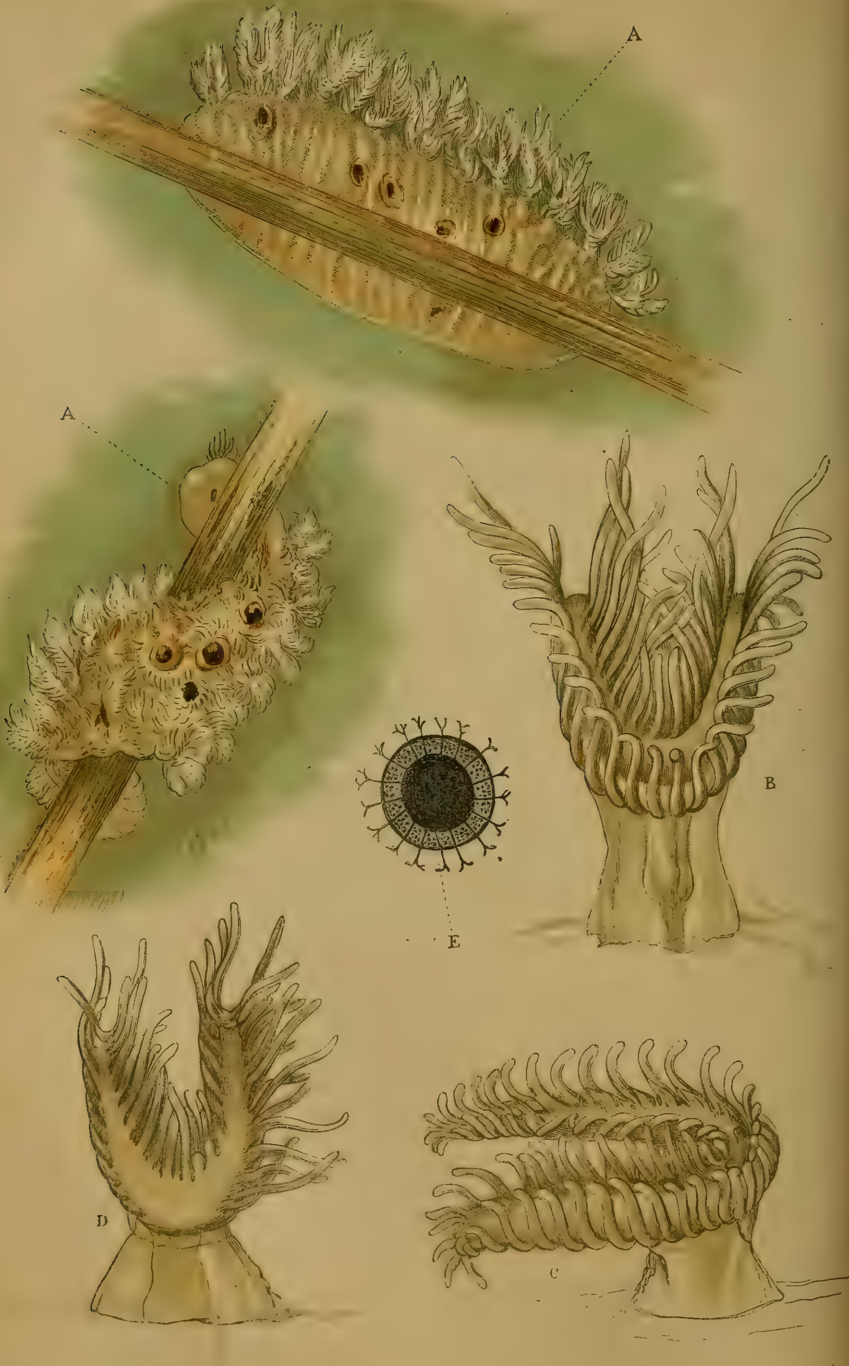
CARDBOARD CELLS FOR MOUNTING MICROSCOPIC OBJECTS.—At a recent meeting of the Microscopical Society, Mr. Henry Lee exhibited specimens of cells cut from tubes of cardboard, which, being very cheap and easily made, will be found exceedingly useful in the mounting of dry and opaque objects. They are constructed in the same manner as the sides of pill-boxes, by rolling gummed paper on a wooden mandril, and cutting rings from the tubes thus formed when dry and hard. It will be seen that they can readily be made of any required depth, diameter, or thickness.

BROWNING'S SPECTROSCOPE BURNER.—Mr. Browning has introduced a convenient Bunsen burner, mounted so as to slide up and down a rod for adjustment of height. The same rod carries a moveable holder for a piece of platina wire, or anything else which it is desirable to introduce into the flame.

ANTIPATHIES OF DOGS.—A brown retriever known to the Editor, very good-tempered to most people, and very quarrelsome with most dogs, recently exhibited decided symptoms of anger when patted by a gentelman he usually made friends with. The dog's master suggested that it was probably because the visitor had been caressing his own dog with the same hand. To test this, the other hand, to which the objection could not apply, was tried, and the retriever immediately manifested his accustomed pleasure at being noticed.

NEW ELECTRO MAGNET.—M. de Moncel has described to the French Academy a new electro magnet devised by M. Carlier, and reported to possess great power. He does not employ covered wire for his spirals, and the statement says the only condition is that the different spiral layers shall be separated from each other by envelopes of paper, and that the bobbins shall be of wood or copper, covered internally with an insulating substance. An electro magnet of this construction, having iron cores $4\frac{1}{2}$ centimetres long (nearly 1·8 inches), and 7 millimetres wide (rather more than $\frac{1}{4}$ inch), with one spiral composed of wire, $0^{mm}{\cdot}277$ diameter,* making 103 turns, supported 3·900 kilogrammes, or more than 8 lbs.

* The millimetre is 0.039 inch. Our readers will find "Dowling's Metric Tables" very useful to solve these questions.



THE WANDERING POLYZOON.
Cristatella Mucedo.

THE INTELLECTUAL OBSERVER.

MARCH, 1865.

THE WANDERING POLYZOON (Cristatella Mucedo).

BY REV. W. HOUGHTON, M.A., F.L.S.

(*With a Coloured Plate.*)

How well I remember the delight I felt on my first discovery of this beautiful little animal! I hardly know of anything in nature more exquisitely lovely than this, the only locomotive* species of the entire group of Polyzoa. Perhaps that wonderful little rotifer, the *Melicerta ringens*, may almost be considered a greater favourite, for *Cristatella* builds no house with bricks she fashions herself, like that other interesting creature. But still *Cristatella* has charms which even *Melicerta* is unable to display. Just look at a full-grown specimen, of an inch and a half in length, with the triple row of most delicate plumes, arranged around the margin of the body in regular concentric form, and I am sure you will quite agree with Professor Allman, (our great English authority on the fresh-water Polyzoa), who has published a beautiful monograph of this group,† and own with him, that a "more interesting and beautiful animal than a fully-developed specimen of *Cristatella mucedo* can scarcely be imagined." If any of my zoological readers are strangers to this little beauty, I must recommend them to make diligent search, when next summer comes, amidst the stems and leaves of submerged aquatic plants in clear ponds, lakes, and mill-pools; but as the successful hunt after delicate treasures is generally attended with difficulty, and perhaps after many days of patient exploration, with much eye-straining and back-aching in addition, it may be as well to give a hint or two how to proceed in order to find *Cristatella.* And here I may take

* One could almost wish that the specific name of *vagans*, so descriptive of the habits of this Polyzoon, first proposed by Lamark, had been allowed to stand; but the laws of nomenclature are rightly observed.

† Ray Society, 1856.

the liberty of referring to my own remarks, published five or six years ago, in the *Microscopic Journal*,* as I have no reason to "change my prescription," and am unable to give better advice. Where, then, to look for, and how to find *Cristatella mucedo*? As to the first question—where to look?—I must answer, in clear ponds, and lakes, and canals. I suspect that *Cristatella*, though generally speaking, little known, is not nearly so uncommon as some people suppose. I am inclined to believe that this species is as frequently to be met with as some others of the fresh-water group, such as *Fredericella* and some of the *Plumatellidæ*, but while in these last cases an upturned stone, or the under side of a submerged leaf or branch, at once reveals the presence of the adherent specimens—for the sponge-like masses of *Alcyonella*, and the branching tubes of *Plumatella*, are evident to the eye without the slightest effort —it is not by any means so easy a matter to detect the presence of *Cristatella*, whose light-coloured cœnœcium can only with much difficulty, and continued straining of the eyes, be seen, as the little colony rests upon some submerged weed or stone, which weeds, in the middle of summer, are sure to be overspread with the filaments of *Diatomaceæ* and other Algæ, thus rendering the detection of the Polyzoon a task far from easy. Every lake, mill-pond, clear canal, or reservoir may be suspected to contain these most exquisite of the Polyzoa. Now the winter eggs, or statoblasts,† are readily found, much more easily than the developed colony; therefore, let the searcher after these aquatic treasures turn his attention to the discovery of the statoblasts, and let him look for them late in the autumn, in the winter, and spring. In order to obtain these statoblasts—little dark circular bodies about the size of a pin's head, an enlarged representation of which may be seen in the plate which illustrates these few remarks—I would say, go to the sheltered spots in the pool, where the wind has blown all the floating rubbish, duck-weed, tangled masses of Algæ, decayed roots of grasses, etc., and carefully examine the rubbish, bit by bit, in your hands if you like, but the best way is to thin out the rubbish in the water, when small aggregated masses of statoblasts will show themselves, varying in size from that of a pea to an inch in length. The isolated individuals are not, as a rule, to be depended upon, for they are generally only the *separated faces of old specimens.* I have taken home frozen up lumps of rubbish, and have from them obtained statoblasts which have duly germinated, though I have never been able to keep the young polypes alive more

* See the Number for October, 1859, p. 59.

† For further remarks on these bodies, and other interesting particulars, the reader should refer to Mr. Slack's paper in the November No. of The Intellectual Observer, 1862, pp. 271—274.

than a few weeks. But if the fully-developed colony is the object of your search, then in the months of July and August, and even in June, if the weather has been warm, go to your pond and seek; be not content with merely stooping down and pulling out the weeds, and examining them in your hands out of the water, for such a search will, in all probability, prove an ineffectual one—it being almost impossible, amid the confervoid growth, to detect the collapsed form of your much-prized *Cristatella*—but lie flat down on the edge of the bank (the Polyzoa are generally within a few feet of the bank, covered by water varying from an inch in depth to about two feet), and put your face close to the surface of the water, staring "with all your eyes;" then, with as little disturbance of the water as possible, clear away with your hand the floating weeds and Potamogeton leaves, and examine every submerged stem *in situ*, just as it grows in the water—with much patience and "great expectations." Probably, for a minute or so, you will see nothing like what you want; but, *nil desperandum*, continue to gaze, and in all probability you will be rewarded by observing, amid the scum and conferVæ, an oblong object, feathery and transparent, about an inch in length. These colonies bear some resemblance, when the polypes are momentarily withdrawn, to the well-known gelatinous egg-nidamenta of *Limnæus stagnalis*.

M. Gervais has compared the polypidom to a piece of chenille, and with good reason; it would not be easy to find a more apt similitude. And now that you have seen one specimen *in situ*, you will find little difficulty in being able to discover several more. When the statoblasts split, which happens in the spring, a single polype emerges; in a day or two another grows or buds out of this one, then another, and so on till the colony is developed. I have found that all the fresh-water Polyzoa are great devourers of the spores of Algæ, of Desmidiæ, and Diatomaceæ; so let the observer, who wishes to keep specimens alive for examination, take care to give them a bountiful supply of such food. *Cristatella* is unique in one respect: of all the Polyzoa, whether marine or fresh-water, this alone is capable of locomotion; the movement is certainly very slow, and not easily noticed. The under surface of a Cristatella colony is like the foot of a gastropodous mollusc. "On this disc, which is contractile, and admits of frequent change of shape," to quote Professor Allman, "the colony adheres to neighbouring objects, or creeps about on the submerged leaves and stems of aquatic plants. From the edges of the disc a flat space extends outwards, passing beyond the external series of orifices in the form of a projecting margin, whose interior is occupied by a series of tubular cells or chambers, visible through the translucent skin, and extending in a radiatory

direction from the disc outwards, but possessing no external opening. The tentacula are about eighty in number." Professor Allman states that the cœnœcium (the common dermal system of the colony) is of a dull yellow or sienna colour, and his figure answers to this description. The colour, however, doubtless varies, according to the nature of food and the water where the creatures are found. From my own experience, I should say that the colour of the animal is *light yellow*, which, when viewed by transmitted light, looks almost white, as in the figures of the plate, which were made from drawings of living specimens, which had attached themselves to sides of the glass vessels in which they had been placed. *Cristatella* in other respects differs from other members of the fresh-water Polyzoa; all the rest prefer shade, they are found under stones and in dark recesses, but *Cristatella* loves to flaunt her plumes in the bright glare of day, and good reason she has to be proud of her beautiful feathers! Again, very coy, and shy, and *retreating* are all the others—shake the glass, and in they pop their little delicate heads, and perhaps won't come out again for some little time; but *Cristatella* is not so shy by any means; she must be roughly handled indeed to cause the individuals of the colony to retire into their cells for any length of time.

I will not write more of this beautiful creature. I only ask "Intellectual Observers" to seek to become acquainted with her; and much obliged should I be to any reader of this magazine if he could send me a specimen or two of *Lophopus crystallinus*, or *Palludicella Ehrenbergi*, two British species of fresh-water Polyzoa, which I have long hunted for in vain.

REFERENCE TO PLATE.

Figs. A represent two mature individuals; the dark spots are the statoblasts imbedded in the cœnœcium. B, D, C represent the front, back, and side views of the exserted portion of a single polype; E, a statoblast showing the characteristic hooked spines; all magnified.

LIFE CONDITIONS IN OTHER WORLDS.

The question of whether other worlds are inhabited by intelligent beings, having other creatures below them, as we have, cannot fail to interest the human mind, and necessarily comes up for reconsideration from time to time as fresh discoveries suggest new thoughts. We have, therefore, thrown together the following pages for the sake of supplying hints drawn from recent investigations. Our object has not been to exhaust the subject, but simply to afford aids for its contemplation.

The association of stars and planets with life reaches back to times when man's dawning reason first studied the celestial orbs, and supposed them the abodes of beings capable of influencing mortal affairs; and when, through the revelations of the telescope, it became known that the planets bore more or less resemblance to the earth, and that the so-called fixed stars might be bodies of the same nature as our sun, it required no great stretch of imagination to conjecture that unnumbered worlds, traversing the fields of space, were inhabited by creatures more or less analogous to man. Fontenelle gave an extensive popularity to these views through the publication of his *Entretiens Sur la Pluralité des Mondes,* in which he asserted that the fixed stars were suns, and that as our sun illuminated planets, so did they. In peopling the various globes, Fontenelle had recourse to a lively fancy, and did not limit himself by any nice considerations of philosophy, so that we are not surprised at his describing lunar cavities, and then asking, "Who knows but the inhabitants of the moon take refuge from solar heat in these great pits?" As science advanced, the different characters of the planets became better appreciated, and it was seen that creatures able to live on our airless moon, or on the huge, light globe of Saturn, must be widely different from those we are acquainted with on the earth. No accurate analogies help us in these inquiries, because our earth does not anywhere exhibit an assemblage of conditions similar to those which any other planet experiences. For example, if we look to Mars, the most earth-like of the planets, we find that by reason of his distance from the sun, he only receives about 43 hundredths of the light and heat that reach us. If this were the only difference, the hottest parts of Mars and the coolest parts of the earth might be compared together; but then we find that from difference of density and size "a body which would weigh one pound on the earth would weigh only half a pound if transported to Mars."* The Martial day of

* Breen, *Planetary Worlds.*

rather more than twenty-four hours and a half does not differ enough from the same terrestrial period to exert any special action upon living beings; but the year contains $669\frac{2}{3}$ rotations, and thus the seasons are much longer than our own.

The polar snow and ice masses visible in Mars afford an analogy to our earth, which is strengthened as the observer sees them, diminishing or disappearing as the Martial summer comes on. That Mars has an atmosphere is obvious from inspection, and it forms clouds and deposits moisture like our own. How far it differs from ours we do not know; but the observations of Mr. Huggins, detailed in our last number, show that it contains substances which absorb a good many of the more refrangible rays, and thus cause the planet to assume a red tint. The extent of the polar snow in winter, as compared with summer, shows that a considerable portion of the planet undergoes great changes of temperature corresponding with the seasons; and from the general disposition of land and water—the reverse of what obtains with us—the general climate must be continental, as contra-distinguished from insular.* It was thought at one time that the atmosphere of Mars extended to a considerable distance from the body of the planet; but the observations of Sir William Herschel, who watched minute stars close to the disc, negative this idea. The weight with which an atmosphere presses upon a globe depends upon its density and its height, and upon the force with which gravitation attracts a given mass. In the case of Mars, the atmospheric pressure or density probably does not differ so much from our own as to render that planet unfit to be the abode of creatures bearing some resemblance to those we are acquainted with.

Mr. Huggins finds evidence for supposing that both Jupiter and Saturn have in their atmospheres the gases that occur in our own, though with what admixture does not yet appear. Venus proved about as intractable under the spectroscope as she does under the telescope. Her clouds reflected solar light, and did not permit any sufficient reflection from the body of the planet of rays that had traversed her whole atmosphere, and been affected by the materials it contains.

The amount of resemblance traced between the atmospheres of Jupiter, Saturn, and that of the earth, increases the probability of their inhabitation by beings performing the functions of respiration. The enormous size of the former planet, which is more than eleven times the diameter of the earth, gives it a

* Astronomers usually consider the dark portions seas, and the bright ones land. The dark parts exhibit as much prominence as could be expected from the circumstance of our viewing them through an atmosphere laden with variable clouds. See Mr. Webb's valuable paper, vol. iv., p. 182.

prodigious attractive power, notwithstanding its mean density is, as compared with that of the earth, as 243 to 1000. A mass weighing 100 lbs. on the earth would weigh from 276 to 224 lbs. on Jupiter, according to whether it was placed at the poles or the equator. The surface of Jupiter may be of very small density, as the mean density is low, and "there is reason to think," as Mr. Breen says, "that it is denser at the centre than at the surface." Jupiter receives about one twenty-seventh of our light and heat. If animated beings live upon its surface, they must probably be of very light construction, as we may suppose dense bodies would sink into it, and perhaps tumble down, by mere force of gravity, through successive strata of this remarkable globe.

Saturn has an average density of about three quarters that of water; and if we imagine that it is not homogeneous, but stratified, its external layers must be composed of very delicate materials. Sulphuric ether has a specific gravity of ·724, water being 1; and this fact will assist comparison. Saturn receives ninety-one times less light and heat than we do, but, from its high reflective power, looks brighter than would have been supposed.

If we assume that gravity and muscular activity stand related to each other in the various planets as they do upon earth, we shall find, as Sir John Herschel observes, "that the efficacy of gravity in counteracting muscular power and repressing animal activity on Jupiter, is nearly two and a-half times that on the earth; on Mars not more than one-half; on the moon one-sixth; on the smaller planets probably not more than one-twentieth, giving a scale of which the extremes are in the proportion of sixty to one."

Unless analogy breaks down altogether, the amount of energy displayed by living objects in any planet will bear a constant relation to the quantity of heat it employs in its life processes. We cannot say to the amount of heat it *receives*, because planets may differ very greatly in the proportion of heat which they retain for home use, out of the total quantity that reaches them. We see this from what takes place on the earth. A dry mountain height receives a large amount of solar heat, and gets rid of it by violent radiation; while at a lower level, and with a moist atmosphere surrounding it like a blanket, other portions of the globe that receive less keep themselves very far above the lowest temperature of the regions just named. Sir John Herschel points out in his *Outlines of Astronomy* that we cannot absolutely conclude that objects on Mercury must be seven times as hot, because that planet receives seven times as much solar radiation as we do. Nor are we to assert positively that Neptune is nine

hundred times colder because he receives nine hundred times less. He says, "The feeble sunshine on a remote planet may be retained and accumulated on its surface in the same way, and (for the same reason) that a very slight amount of sunshine, or even the dispersed heat of a clouded day, suffices to maintain the interior of a greenhouse at a high temperature."

The amount of force that can be exerted by a given weight of muscular fibre appears to differ very much in terrestrial creatures, and so does the amount of strength and cohesion of bodies of nearly the same density. None of our larger terrestrial animals exhibit, on their scale, anything approaching to the strength which insects manifest on a smaller scale; and if we compare the action and continuous motion of cilia in animalcules * with the minute portions of matter that are concerned in keeping them going, we are led to conceive that, in some other worlds, considerable locomotive powers may exist in larger creatures not cumbered by our weight of flesh and bone.

The relation of density to cohesion varies exceedingly in substances we are acquainted with. Compare, for example, the solidity of a bamboo with the mobility, and in that sense weakness, of the much heavier body, water; the tenacity of gold, so great that a single grain may be drawn into five hundred feet of wire, with the brittleness that may be communicated to the same metal by combining it with small quantities of certain other substances, so as not materially to change its specific gravity.

It is reasonable to suppose that in planets differing materially in size and density from our own, and also in the quantity of solar heat and light which they receive, the cohesion of substances within a certain range of density may vary much more than they do on the earth, and we must therefore be cautious in our guesses as to how much firmness or weakness may exist in the surface materials of the various planetary worlds.

Recent remarks have shown us that terrestrial life exists under a wider range of conditions than was supposed. On mountain heights, where the atmosphere is half, or less than half, what it is at the sea level, life still appears, and even so highly organized a creature as a condor can soar for hours together 18,000 feet above the sea level, and can live and breed at 10,000 to 15,000 feet elevation. At 18,480 feet the atmospheric pressure is reduced one-half. Dr. Wallich, who has importantly added to and confirmed what was previously known of life at great sea depths, tells us that the Rhizopods

* Ciliary motion is not occasioned by muscles—no one knows how it is produced, and it is found in plants as well as in animals.

called *globigerinæ* are found at depths varying from 50 to 3000 fathoms, and he obtained a live star-fish from 1860 fathoms. At the depth of a mile, the sea pressure amounts to 2640 lbs., or 160 atmospheres, on the square inch. The quantity of free air or oxygen at these great depths must be very small, and respiration low. We may also remark that animalcules can exist in water placed under an air pump, and consequently deprived of a great portion of its air.

The question of the range of temperature that terrestrial creatures can sustain has been considered in one of our recent papers, entitled, "Aids to Microscopic Enquiry;" but, as we have seen, we cannot tell the quantity of heat at the disposal of organisms in the different worlds. Perhaps more light may be thrown upon our speculations if we reflect upon the remarkable discoveries of Tyndall, on the heat absorbing power of aromatic vapours, that of aniseed being 372 times as great as that of common air. Thus the existence, even in moderate proportion, in the atmosphere of any planet, of some heat-absorbing body not found in our own, might very materially affect the temperature to which creatures living on it would be exposed.

In speculating on the power of animals in other worlds, of either producing heat in very cold climates, or resisting it in very hot ones, we may consider the bad conducting properties of many substances we are acquainted with, and of the cooling action exerted by the evaporation of bodies taking up considerable quantities of heat. Our terrestrial plants generate some heat in their vital processes, but, for the most part, too little to enable them to accommodate themselves to a very low temperature. There are, however, cases of very considerable heat being generated by plants in their flowering season, and Dr. Carpenter cites an instance of an *Arum cardifolium* raising a thermometer to 121°, while the temperature of the surrounding air was only 66°. The main source of the heat generated by plants and animals arises from a slow combustion or oxydation of some of the materials they contain, and we find terrestrial creatures adapted to an atmosphere containing only about one-fifth of oxygen. It would be a variation of degree, not of kind, if in other worlds a larger proportion of a gas supporting combustion were supplied, or if organized beings were adapted to burn certain materials at a greater rate.

Mr. Huggins's spectroscope researches lead us to the belief that the atmospheres of the coloured stars absorb a sufficient portion of the complementary rays to give them their peculiar tint. Thus Betelgeux, an orange star, and Aldebaran, a pale red one, exhibit spectra full of lines in the places of rays complementary to the star tint. Aldebaran is described as having

abundance of such dark lines in the orange, green, and blue, and the stoppage of such portions of the spectrum leaves the pale red tint which we see. Now if this be the rule in coloured stars, it will follow that their planets receive rays mixed in different proportions, and as different coloured lights have a different effect upon the growth or organisms, we must expect the planets of a red sun to have a different fauna and flora from a green one. To what extent chemical rays are stopped by certain sun atmospheres, and transmitted by either, we have little knowledge; but the actinic power of some brilliant white or sapphire stars is much higher than that of others which are inclined to an orange tint.* When a binary system exposes its planets to an alternate or varying influence of two distinct coloured suns, not only would their skies and scenery present a splendid and changing aspect, but the sort of stimulus and the amount of excitement given to living organisms would vary too.

The last considerations we shall at present offer refer to a large number of facts now in the possession of naturalists, which show that particular types both of plants and animals may occupy a widely different rank from that which we are accustomed to see them in. Hedgeside weeds in this country are, in many cases, the local representatives of plants that reach ample dimensions in other lands, and the humble reptiles of our roads and ponds claim relationship with gigantic creatures which were little less than the lords of creation in earlier stages of our planet's life. Who knows but that the plants and animals of other worlds are so related to our own, as that they may exhibit the perfect condition of types that are only seen by us in a rudimentary form?

* Most of our astronomical readers will remember a note to page 111 of Mr. Webb's "Celestial Objects," in which it is stated, that "the American astronomers at Harvard College, with the great 22-feet achromatic, have found that Wega surpasses Arcturus in photographic power no less than seven times; presumably from its different hue."

ON TRANSMITTED ILLUMINATION IN CONNECTION WITH THE STRUCTURE OF THE SILICEOUS DIATOM VALVE.

BY RICHARD BECK.

It is undoubtedly a remarkable fact that, after all the careful microscopic examination which has been bestowed for so many years upon the siliceous valves of the Diatomaceæ, no person has yet been able to give any explanation of their structure, which could universally be received as satisfactory.

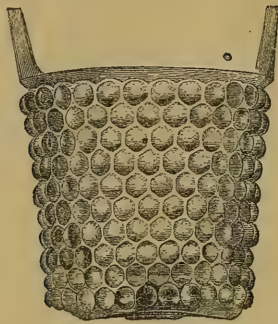
A few observers appear to have had no difficulty in satisfying themselves as to the cause of those markings which are so familiar to every microscopist; but the opinion of almost every one, who has refrained from any published statement, is as undecided as possible.

I believe the conflicting ideas of some, and the uncertain opinions of others, are easily accounted for by the peculiarities of the case; of these I would especially draw attention to that of the siliceous valve being formed of a perfectly transparent material, and consequently when light is transmitted through it, the markings appear because of the refraction or the reflexion of the light by the various irregularities of structure, and not because of the dispersion or absorption of the light, which so invariably and materially assist us in the determination of almost all natural objects.

Again, it is very seldom indeed that any truly transparent natural object is presented to the naked eye in the ordinary course of our existence, and still less, frequently, under such circumstances as to have a direct light transmitted through it; the only instances that occur to me just now, are the drops of falling rain, or flakes of snow as seen against a light sky, and consequently the eye from not being accustomed to the appearances of transparent objects, is quite unable to come to any judgment upon their appearances.

It has frequently occurred to me, and probably to many others, that some objects of a tangible size might be found to show the difficulty of determining the structure of transparent objects from the appearances produced by passing light through them, and it was quite unexpectedly that I met with a common small glass tumbler, the lower portion of which was covered with small hemispheres. The difficulty of determining the structure even of this large object, when looking perpendicularly though the surface, is at once apparent, and may be seen as well in the accompanying engraving, copied from a photograph,

which was taken after the tumbler had been cut in half, so that the posterior side should have no influence over the illumination or the appearances presented by the anterior surface.*



Now I think every one who will impartially look at the copy of this photograph of the tumbler taken under the conditions of illumination which I have mentioned, must admit that it is impossible from such appearances to determine the true structure; and to show how small an influence may operate upon the mind, in coming to any conclusion, it will be found that merely altering the direction of the illumination exactly reverses the appearance—this change resulting entirely from a very slightly unequal illumination of the hemispheres which conveys the idea of shadow, and consequently elevates or depresses the markings according to the direction of the light by which it is examined.

I do not bring this instance forward as a proof of what the structure of any one diatom valve may be, I believe it would be most hazardous to draw any conclusion whatever: for my own idea is, that a piece of glass covered with hemispherical depressions, or even perforated, might be made to produce very similar appearances.

It may reasonably be asked, what value can attach to such an illustration as this tumbler affords, for the purpose of determining the peculiar and minute structure which no doubt belongs to the diatom valve? I can only give my opinion that it must be taken as negative evidence, and I would recommend those observers who are anxious to determine the correct structure of the siliceous diatom valve, to take into consideration its function, and consequently the formation that that function

* The cut should be viewed as it stands, and then when turned upside down. A piece of paper having a hole in the middle three quarters of an inch square, and laid over the engraving, conceals the true form, and makes it look exceedingly like a portion of a diatom valve.

may require; for how can any reasoning be sound when based merely on the appearances of the markings under the microscope, which, as I have endeavoured to show, may be entirely due to the peculiarity of the illumination, and may give not the least indication whatever of the true structure?

PINK MONADS AND THEIR ENEMIES.

BY HENRY J. SLACK, F.G.S.,

Member of the Microscopical Society of London.

It is no disparagement to Ehrenberg's genius and industry to say, that the group of Monads (*Monadina*) contains objects that must be entirely re-arranged. Most of them are plants, not animals, and many are probably only rudimentary forms. In the last edition of Pritchard's valuable work, Dr. Arlidge treats the Monads as belonging to a family called *Phytozoa*, composed, as the name indicates, of "plant-like animals." An arrangement of this sort can only be provisional, because many of the objects do not present any animal characteristics, as the mere power of locomotion cannot be considered to deserve that name. The so-called *Phytozoa* comprehend *Monadina, cryptomonadina, hydromorina, volvocina, vibrionia,* and *astasia*. The extreme minuteness of many of these objects, and the very small size of their parts, or organs, rendered it impossible that many details could be made out with the object-glasses used by Ehrenberg or Dujardin, and hence we need not be surprised that the former made the mistake of supposing that they possessed a plurality of stomachs, or that the latter found himself unable to do more than suggest artificial appellations, intended merely to facilitate their recognition. The Monad group is divided into two portions, one consisting of isolated individuals, and the other of aggregated individuals. The former are named according to their possessing one or more vibratile filaments and the position in which they are placed; the latter are either always free, or at some portion of their life attached by a stalk. Such an arrangement is evidently artificial, as aggregate groups may, and in many cases do, result from single individuals or spores.

A source of difficulty to students of these organisms arises from the confusion between old and new modes of treating them. Ehrenberg, as we have said, thought them all animal,

and we still find genera, to which animal terms are applied, mixed up with other genera concerning which nothing animal can be predicated. It is not, indeed, easy to say what is an animal or what is a vegetable, and Dr. Burnett observed some years ago, in an introductory note to his translation of Von Siebold's *Anatomy of the Invertebrata*, that "all the older criteria by which animals were separated from plants have long since been regarded as invalid; and some of those which in late years have been regarded among the most constant, have, quite recently, been declared as equally unsound. Cellulose has been shown to be a component of animal as well as of vegetable structures, and Kölliker has insisted that some forms that have neither mouth nor stomach, but consist of a homogeneous mass, are true animals. If these premises are correct, nothing will remain, I conceive, for a distinctive characteristic, but voluntary motion." Afterwards he says, that if stomachless creatures be admitted as animals, still the existence of a stomach should be regarded as proving that an object is not vegetable. Whether or not motion is voluntary, is often an extremely difficult problem to decide, and where no distinct animal organs are present, the class to which the creature belongs must be decided by its preponderating affinities rather than by any one characteristic, and particular attention must be paid to its mode of origin and embryonic forms. A stomachless, organless thing, like the Gregarina, is recognized as an animal partly on account of its young form resembling an Amœba, and thrusting out similar processes. The negative evidence against this, the possessing neither mouth nor stomach, does not deanimalise it; as the tape-worm, which no one would dream of supposing a plant, has no such organs. Moreover, the nutrition of the Gregarina is that of an animal; but as it lives in other animals in contact with their juices, it can imbibe and assimilate them, without the machinery for taking in solid matter, and reducing to a fluid state, which is requisite for the mode of life of other animals higher in the scale.

The absence of a mouth does not suffice to indicate that a living object is not an animal; but the possession of a true mouth is evidence the other way; and none of the various things called Monads, in which mouths can be detected, ought to be associated with other creatures in which nothing but vegetable characteristics can be traced. When an object is not in its complete form, but only a germ, or early stage of something else, it should not be classed with others that may resemble it, but which do not develope into anything else. Until, therefore, the life history of all the objects called Monads is ascertained, their true classification cannot be effected, and

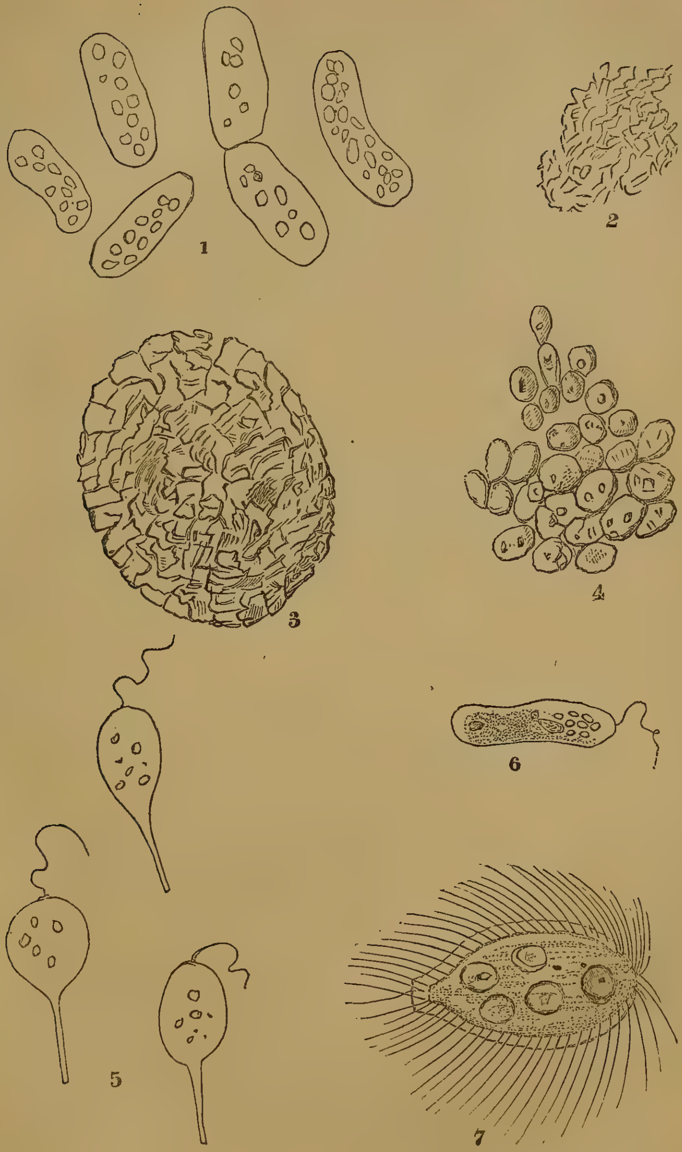


Fig. 1. Pink Monads (Chromatia).
Figs. 2, 3, 4. The same in early stages.
Figs. 5, 6, 7. Animalcules preying upon the Pink Monads.

I cannot pretend to say exactly where the pink Monads I shall proceed to describe may have to take their stand.

In the beginning of December, in company with a friend, I examined some ponds just beyond Highgate Archway, on the left of the road, and found few symptoms of life. After many ineffectual dips, I brought up a small twig of some dead plant which had a reddish hue from the adhesion of minute particles, that a hand magnifier could make nothing of. Thinking the unknown objects were probably alive, I brought them home, and proceeded to examine them with a $\frac{1}{5}$th. The sight was curious in the extreme. A few particles of the red matter had been placed in a drop of water on a glass slide and a thin cover over them, and when I looked through the microscope, hundreds of little sausage-shaped things of a rose-pink colour were moving through the field. They were transparent, and for the most part contained little vesicles of a different refractive power. Their mode of motion was very peculiar. Sometimes they moved nearly horizontally, with a wriggling contortion of their bodies; at other times they stood upright in the water, and spun round and round about their long axis, *appearing* to go very fast, but in reality making their tee-to-tum performance to rather slow time, as was shown by the fact that under a magnification carried as far as 1750 linear, by means if a $\frac{1}{20}$th, the vesicular spots could always be seen separated from each other, which would not have been the case if the rotation had been quick. The little bodies varied in size, some appearing half an inch long, and others about three-quarters when magnified 1750 linear. The width was about one-third of the length. Both smaller and larger were observed, but the majority were within the limits mentioned. The colour was a beautiful rose-pink, and the vesicles looked lighter or darker, according to the way in which they caught the light. Some only contained a few vesicles, others were stuffed full of them, as shown in the drawing. A reference to Pritchard shows that they belonged to the genus *Chromatium* of Perty, of which the description is, " body extremely small, red, brown, green, or violet in colour, containing in the mature condition some internal vesicles. A motor filament at the anterior extremity (?). Multiplication by transverse fission." In a description of *Chromatium Weissii*, it is stated that Perty could not find the alleged motile filament, and I am satisfied it was not present in my specimens, as their mode of progression evidently depended upon another sort of mechanism. No objects are more difficult to make out than extremely small filaments which have as nearly as possible the refractive power of water. Letting a specimen dry will not succeed with the most delicate of such

objects; but changing the refracting power of the water with a little glycerine sometimes will. Cases will occur in which with all care the presence or absence of such a filament must be inferred. Thus I found associated with the Chromatia a number of extremely minute euglenæ from a ten-hundredth to a fifteen-hundredth of an inch long, and it was only in a few specimens the filament could be occasionally seen, though, doubtless, present in all.

In searching for any filament that might be present in the Chromatia, I adjusted the glass and illumination so as to show it in other delicate objects in the same field, but never detected any symptom of such an organ in any one of them. The motion was evidently effected by expansion and contraction of the delicate membrane covering the little objects, and when one of them was in a favourable position a wave motion was seen from one end to the other of the integument. In the annexed plate, a very large Chromatia, is shown in the act of division, but I think the chief method of propagation takes place in another way. After whirling and spinning and wriggling up and down and backwards and forwards for a considerable time, the little sausages grew quiet and settled down among a mass of their brethren, who had likewise retired from the dancing dervish part of their business. They were not dead, though no longer acted upon by "life's fitful fever," and, I believe, in their quiescent state the vesicles escaped and commenced a new growth. When a mass of stationary Chromatia was examined, it was found to be cemented together by a sort of pellicle, in which various objects, including the lilliputian euglenæ, were embedded. This mass likewise exhibited particles of pink matter in various stages of growth, as shown in Figs. 1 to 3. I could not obtain any positive proof of the fact, but I think the little objects in these patches were developing into Chromatia; at any rate a tolerably complete series of forms intermediate between the little dots in Fig. 1, and the objects in Fig. 4, could be traced, and it will be seen that Fig. 4 closely approaches the Chromatium form. All these objects had a pink tinge, but it was deepest in the full-grown specimens.

When I first brought the pink Monads home, there were very few full-grown ones that did not exhibit many vesicles; but, after the bottle containing them had been a week in the house, the majority had very few vesicles, and some none at all, though quite large enough to be entitled to many. The development of vesicles had evidently been checked by want of some conditions I was unable to supply.

It is of no use to give such objects specific names, unless it can be shown from their life-history that they are really

distinct from other objects much like them. The colour cannot be taken as a sufficient distinction to mark a species, nor can variation in size, unless both striking and hereditary. My Chromatia were all rose-pink, but I should not regard them as distinct from violet or brown sorts. They colour mud and other objects at the bottom of ponds. Those I took were only a few inches under water, and the hue is probably affected by the depth at which they grow, and the quantity of light they receive.

The most active enemies of my pink Monads were the creatures represented in Fig. 5. It is quite impossible to represent the delicate structure of these objects in any engraving. The reader must imagine the globular body to be white and transparent; the little dots inside them represent vesicles obtained from the Chromatia, and ingulped by a mouth opening wide and slantingly near the filament. Not a vestige of this mouth could be discerned except when it was in the act of opening or shutting. No definite internal organs could be discovered in my specimens, but no doubt some existed. The filaments were so delicate and colourless that they could only be seen at favourable moments. The slightest motion which took them out of the exact focus, or the best possible illumination, rendered them invisible. The tails were still more delicate, and although both head and tail were frequently seen in the same individual, it was rarely possible to focus both at the same time. Their tails were susceptible of considerable variation by lateral expansion and contraction, and the animals could change from the globular form to a pear shape, or even to the shape depicted in Fig. 6, which represents what may be another species, as it had no tail, and did not become either globular or pear shaped. The most common forms of these animals are represented in Fig. 7. They were very active, swimming freely, squeezing themselves through obstacles, and dashing furiously against the Monads. Sometimes they swallowed a little Monad whole; but their usual plan was to tug and thump at the big ones until they could get at their contents. The object depicted in Fig. 6 was less common, but apparently engaged in the same business.

Fig. 7 shows an animalcule remarkable for the length of its cilia. It had a conspicuous contractile vesicle and a mouth at the smaller end. It was an active creature, and seemed fond of the Monads in an early stage of their growth.

In one instance, one of the Fig. 5 objects used his tail as a foot, and sprung up and down from it, but without the jerk of a Vorticellid.

I have seldom met with prettier objects than the pink Monads and their enemies, and if any of my readers notice a

delicate deposit of pink or any other colour at the bottom of a pond, I recommend them to bottle some of it for domestic use. The sketches which illustrate this paper are from drawings by my wife; the objects are all magnified 1750 linear.

THE AUSTRALIAN SATIN BIRD AND THE KING PARROT.

BY "AN OLD BUSHMAN."

THE male Satin or Shining Bower Bird (*Ptilonorynchus holocericeus*), with his silky, glossy, purple coat and bright blue eye, is, perhaps, take it altogether, one of the most beautiful birds in the Australian forest. But it is not so much on account of the beauty of plumage that I bring this bird before the notice of the reader, as to offer a few remarks on those peculiar little structures called "bowers," which these birds erect in certain places in the Australian bush for the purposes of mutual recreation, and *totally independent of, and often at a considerable distance from, their nests.* These bowers are, I believe, built, and certainly are used by more than one pair of birds. Like human edifices, they do not appear all to have equal care bestowed upon their construction, or equal taste shown in their decoration, and, although uniform in their plan, I do not think that they are equally so in their dimensions. They may, however, be generally described as being in plan an oval, intersected at either end by a wing, or entrance to it. The greatest width of the oval is generally about eighteen inches, that of the wings about eight inches at their points of junction with it. The floor of the oval or bower, and of that portion of the wings immediately adjoining it, is paved with small sticks, along either external edge of which is built a little ridge composed of sticks laid longitudinally, and forming, as it were, two wall-plates. Into both of these wall-plates a compact hedge of sticks is then inserted; these on either side inclining inwards, at about an angle of sixty degrees from the actual covering of the bower, leaving a small space open at the top, varying in size from one to two inches. These sticks are longest in the centre of the bower, and are shortened as they approach either wing. The wings widen as they recede from the bower, and those forming their sides are placed further apart; these also incline inwards. The whole of the sticks

used in the construction of this little edifice are either peeled, or else have a beautifully smooth bark. The decoration of the bower is accomplished by sticking the feathers of gaudy parrots into the wall-plates, especially where the bower and wings intersect each other. The whole of the flooring is also more or less thickly strewn with these feathers, especially at the entrance of the wings, forming a kind of tesselated pavement to the whole affair. It is most ludicrous to watch the grotesque postures and attitudes of a group of satin birds at play in one of these bowers.

Scarcely less beautiful in plumage, and quite as interesting in his habits, is the Spotted Bower Bird, which is very common on the Murray, frequenting the densest part of the mallee scrub. Shy and retired in its habits, and certainly not so gregarious as the bird last described, the male bird of this species is certainly a very handsome fellow, of a rich brown covered with buff spots, and a broad stripe of feathers growing out of the back of the neck, bearing a remarkable resemblance to the flower of a Scotch thistle. But the Murray bird lacks the splendid eye of his royally apparelled brother of the Western port district, of whom, when in full and mature plumage, with his glossy coat of satin-like softness, the lustrous depth of whose purple hue is enhanced by the still brighter glories of a peerless eye, it may be fairly said, he is justly entitled to be classed among those "things of beauty" which are "a joy for ever."

I do not think that any country in the world is richer than Australia in different species of the parrot tribe; and brilliant as many of them are in their colours, to my fancy there is none to equal the King Parrot (*Aprosmictus scapulatus* of naturalists), nearly the size of the magpie at home; the body colour of a rich glossy purple green, with a breast of flaming red. The king parrot, as he floats from one green tree to another, is one of the most splendid objects in the Australian bush, and, although the red lory is a magnificent bird, he must yield the palm to the parrot we are now describing. However, beyond the gorgeous plumage of this princely bird, there is little of interest to be said respecting him, for, unlike the lyre bird, he has no language, save the confused jabber of his "corroboree" notes, and the short, but shrill pipe of his monotonous call-note. Unlike the bower bird he is no builder, and I introduce him here simply in illustration of the fact that Victoria has also her birds of beauty, which can scarcely be surpassed in richness of plumage by those of the sunniest clime. The geographical range of the king parrot is I believe very extensive, but in Victoria, the Gipps' Land district is undoubtedly his chief abiding place, for the further east you

travel, the oftener will your path be crossed by this "dashing pioneer." It is also seen frequently in the Goulburn district, and I have met with him as far north as Mount Hope; but there, as in some other places, I found that he had a dangerous rival in the graceful and golden-fronted green leek parrot, and a little lower down the Murray by the more sombre, yet noble black-tailed lory. He is often to be seen in the Bass River district, sometimes accompanied solely by his unpretending queen, at others in the mixed company of his compeers. Here, during the months of winter, they are to be found in many of the gullies on the mountain ranges, keeping company with the lyre bird and the Yankata cockatoo; and in the same gully, and doubtless often under the same trees, whilst they are quietly feeding in the upper branches, the lyre bird is talking to them in their own language at the foot. At this time of the year they are remarkably quiet, and, owing to the density of the upper foliage in these mountain scrubs, you may traverse gully after gully in these sequestered ranges, swarming with king parrots and other birds, and yet be entirely ignorant of their presence, and the only way to arrive at a knowledge of their vicinity is to repeat at intervals their short and monotonous call-note, and then as likely as not you will hear it answered from a tree under which you have just passed.

In the spring the greater portion of these birds leave their mountain home, and descend into the lower country adjoining it, and when this is the case, our friend proves himself not only the "king of parrots," but the "king of robbers," stripping the fruit from the trees in the settlers' gardens; and of all vegetables, potatoes appear their favourite. After a time they return to the ranges to rear their young, and when this is done they reappear with augmented forces to "raid" in the surrounding country. I think the king parrot right well and worthily named; for although some may perhaps say that the dashing dress of the blue mountaineer is brighter in its hues, and that of the crimson-coated lory deeper in its dye, yet neither the one nor the other, nor in fact any of the parrot race, can, in my humble opinion, vie in stateliness of carriage or splendour of appearance with their "titled king," for the bright red tint of his front and lower garniture stands forth in bold relief from the dark purple and green of his lordly back, while the bright reflection from his dark green wing, as it flashes in the rays of the noon-day sun, dazzles the eye of the beholder, and proclaims the presence of a "Prince of the Birds of Air."

THE DOG AS A CULPRIT.

BY JONATHAN COUCH, F.L.S., ETC.

The history of the dog, with its peculiar sagacity and fidelity, has been treated of in several volumes especially devoted to the subject; and numerous are the tales illustrative of the same which still remain unrecorded, but which ought not to sink into forgetfulness. But there is a portion of the character of this animal which appears to have escaped the notice of the writers of canine biography, but which has so far a bearing on its acquired or intuitive intelligence as to show that there may be times when its fidelity to the master or the public property may be at fault, while the powers of reasoning and the force of cunning calculation are not diminished.

The state of things to which we refer is well known to farmers, and, as far as our information goes, appears to be confined to that variety of the canine race which is employed in the care of sheep; which form or variety of this animal is believed to stand the nearest to what is understood as the primitive, or natural condition of the race, and which may therefore be judged to be disposed more naturally than others to fall back into the true state of nature, and to be less influenced or governed by anything which education or long habit may have implanted within it, but in which the love of selfish indulgence has again become the governing principle, and what remains of the artificial state is employed only in its own behalf. Other animals which have been brought into subjection to the dominion of man have sometimes shown a propensity to fall back or return to the primitive condition of their race, of which what we term wildness, and an ungovernable appetite, are the usual characteristics; and even the "half-reasoning elephant" is not always exempt from the same propensity; but in the case of the dog it is remarkable, above what has been noticed in other creatures, that with the savage appetite which has excited the individual to throw aside the long-practised restraint of education, there should be brought into exercise so large an amount of shrewdness as even to exceed what has been manifested on ordinary occasions.

When, therefore, it happens that, amidst the fulness of an abundant larder at the house, a craving shows itself for a supply of raw and newly-slain mutton, it is not from the nearest, and still less from its master's flock, that the want is to be supplied. We can scarcely admit that in this there is any special regard for the master's interest, or love for the individual sheep of the flock; for the depredator trots off to a

considerable distance from even the fields of a near neighbour, for whom no particular feeling of regard can be supposed to exist. The mischief is also to be inflicted in such situations and under such circumstances as appear the least likely to be traced, or the source suspected from whence the robber has come. As the injury brought on the flock is inflicted at night, it is highly probable that the first will pass without a discovery of the perpetrator. But impunity will bring upon the offender the largest degree of danger, and a watch is kept; under which circumstances it is that our earliest observations have been made, in pursuing which we have been impressed with the amount of stratagem that has been put in practice, more especially to secure the escape of the criminal, and even to divert the suspicion which might alight upon him. The only failure in calculation of results appears to be, that where it has been successful already, a dog will probably resort again to the same field for the same object, without being aware that a second attempt will probably lead to discovery; but in all besides, no London pickpocket is better versed in the subtleties of his art.

As illustrations of the foregoing remarks: A dog was observed to have throttled a sheep, and after having satisfied its appetite, it went down to a neighbouring mill-pool, with what intention it is easy to guess, and there, not aware of being noticed, it washed itself thoroughly, and then came to the bank, where it dragged itself along the ground; after which it went again into the water, rubbed its mouth in the grass, and only after a long time did it venture to return to its home—there, however, to suffer the penalty of the transgression, the whole of which had been seen, but of which, if there had not been other evidence, the appearances on the dog could not have been brought as a proof.

On another occasion, a dog had killed some sheep at the distance of about a couple of miles from his home, and in a secluded situation; but being discovered in the act, it was shot at with a gun, wounded, and pursued. The farm which was its home was on the east border of a promontory that projected far into the sea; but instead of proceeding straight to the shelter of its residence, the road to which was not difficult, although intersected with several cross roads, it ran first to a beach far on the west side of the promontory, and from thence swam out among the rocks, on some of which it effected a landing two or three times. It landed finally on the east of its master's farm, and there was observed to wash its bleeding wounds; after which the parts were rubbed in the earth, and at last it crept up slyly to its own house, where it lay down on the straw with the appearance of being asleep. The

pursuers who had traced the proceedings of the dog had, in the meanwhile, roused up the master from his bed, and they proceeded together to drag out the murderer from his lair; but in doing this, poor innocent! it appeared altogether drowsy and unconscious of harm. Proof was, however, afforded, even to the master's conviction, in the discovery of the bleeding wounds, and summary vengeance was the result.

A dog had worried and much injured a sheep at the distance of a quarter of a mile from its master's house; but being discovered by the farmer, who knew the dog, it made all haste to its master's house in the neighbouring town, where the master was sitting by the fire, and another dog lay at his feet asleep. Advancing, with all the appearance of conscious innocence, this one lay down by the side of its canine friend, and presently assumed the appearance of being also asleep. Presently, however, the unwelcome pursuer appeared also, and began to tell the tale of the injury inflicted on his sheep. The really innocent dog continued to sleep on; but the conscious culprit, without looking up, crept silently away, not directly, but round the room, and was not long in quitting the house. Very near to the master's house was a cellar or room, which was used for the purpose of *barking* the nets of the fishermen, and a portion of the apparatus consisted of a boiler with a flue, close into which latter it crept, entirely out of sight, and there it was discovered, to suffer the necessary consequence of the crime. It is clear that in this instance the dog not only knew the person of its pursuer, but the purport of his tale, as well as that its attempt to lull suspicion had failed of effect.

Subtlety, as deep as in these instances, we have known in a captive fox, and almost as deep in a cat; but in these actions of the dog, a nearer approach is made to the human vice of hypocrisy than we have noticed in any other animal.

While on this subject we will add another narrative, which represents this creature in a more amiable point of view. A gentleman possessed a retriever bitch, which had produced two broods of puppies, all of which had been taken from her and drowned. She was about to produce another litter, and was observed to have searched through every corner and spot about the house; but after a time she disappeared, and when again seen it was plain she had been relieved of her load. Search was then made for the young ones; but it was long before they were discovered, and then it was far from the house—in a secret place on the shore of the sea, near where otters had had a residence; and even then the place was so chosen among the rocks that the young ones could not be got at. It is plain in this instance that the resolution for this proceeding had been formed in the mind long before, although only lately carried out.

MICROSCOPIC CRYSTALS (URIC ACID AND ITS DERIVATIVES).

BY GEORGE S. BRADY, M.R.C.S.,
Secretary to the Tyneside Naturalists' Field Club.

(*With a Tinted Plate.*)

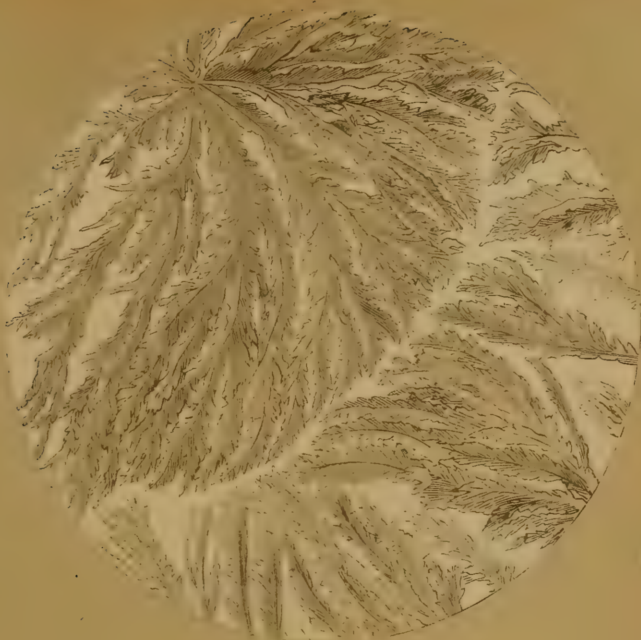
A PAPER on Crystallization in the November part of the INTELLECTUAL OBSERVER, noticing the experiments of M. Kuhlmann, reminds me of a remarkable group of salts, very little known except to purely medical or chemical students, but exceedingly interesting in a microscopic point of view, some short account of which may be acceptable to the general reader.

The compounds to which I refer are derived from uric (or lithic) acid, a substance met with abundantly in most animal excretions, but most plentifully in those of the boa constrictor, and other serpents, the semi-solid excrement of which consists almost entirely of this acid, in combination with ammonia. From this impure urate of ammonia the acid is obtained by the following process:—The material to be operated on is dissolved in boiling water by the addition of caustic potash, until the liquid becomes alkaline. The hot solution of urate of potash thus produced is then filtered, and treated with an excess of hydrochloric acid, which at once precipitates the pure uric acid in a heavy crystalline form.

The forms assumed by uric acid crystals vary very remarkably, according to the character of the solutions from which they are produced, being much influenced by the nature of the precipitating agent, the organic matter held in solution, and various other circumstances. Like other crystals, however, the finest specimens are produced the most slowly. Those occurring naturally in human and other secretions are often strongly coloured of a deep reddish brown, and have on this account obtained the name of "Cayenne Pepper" crystals, a designation, however, which may be held to have also a covert reference to the gouty subjects in which they most frequently occur. Some of the forms in which this acid crystallizes are represented at Fig. 2 of the accompanying plate.

When uric acid is added gradually to strong nitric acid, it is dissolved with effervescence, and with considerable evolution of heat, owing to which, indeed, the operation may become unmanageable, if not cautiously and slowly conducted. In the warm liquid there shortly appear crystals of a compound called *alloxan* and, on cooling, these increase greatly in numbers, so that from 100 parts of pure uric acid, 90 to 105 parts of hydrated

1



2

MICROSCOPIC CRYSTALS.

Alloxanate of Ammonia.

alloxan may be obtained. A solution of this substance stains the skin pink, but its crystals have no particular interest to the microscopist, and it is important chiefly as a stepping stone to the production of other compounds.

Alloxantine, a compound slightly different from the foregoing, is prepared by passing through the mother-liquor of alloxan a current of sulphuretted hydrogen gas, and by the action of ammonia on a solution of these two substances (alloxan and alloxantine) is formed one of the most splendid of chemical products, *murexide,* the crystals of which are beautiful objects for the microscope when viewed either by reflected or transmitted light. By transmitted light they are of a deep red colour, but by reflected light of a metallic green, very like that seen on the elytra of some insects, such as the Spanish blistering fly (*Cantharis vesicatoria*). In the preparation of the crystals of murexide, small quantities only of the required substances should be used, and for the precautions necessary both in this and other similar operations, as well as for full instructions as to their successful performance, the experimenter cannot do better than refer to Dr. Gregory's *Handbook of Organic Chemistry.* To give these details here would be tedious, and out of place.

Several other compounds of this series form excellent microscopic objects. *Alloxanate of ammonia,* when slowly crystallized, sometimes disposes itself in feathery forms of the most exquisite beauty: one of these is represented in Fig. 1. *Uramile* crystallizes in little feathery balls; *oxalurate of ammonia* in radiated hemispheres, and *thionurate of ammonia* in small rectangular plates; the two latter salts polarize beautifully.

One cannot but be struck with the similarity which many of these crystals bear to the lower forms of vegetable life. Those of uric acid, for instance, delineated in Fig. 2, must remind the microscopist of many familiar objects. The oval or "lozenge-shaped" crystals are very similar in form to certain diatoms, even to a median longitudinal fissure, seemingly splitting them into two valves. Others remind us forcibly of the Desmidiæ, especially of the genera *Micrasterias* and *Euastrum,* while we could scarcely have a more accurate or graceful idealization of some of the familiar red algæ than is presented in the crystallization of alloxanate of ammonia (Fig. 1). Even to the proliferous method of branching from the central midrib, this is wonderfully true to the sea-weed character. An artist might have designed it from the genus *Delesseria,* but would scarcely have produced a work at once so elegant and so vitally true.

Of course it may be said—perhaps truly said—that these resemblances are mere matters of coincidence. Certain it is, that though of constant occurrence, the laws which govern

their production are but very imperfectly understood. We are told that the arborescent forms assumed by hoar-frost are the result of markings of the surfaces on which it is deposited. Still, though such markings do influence the particular form assumed, they do not impress upon the crystals the *disposition* to follow curved lines and mimic the forms of vegetable life. We seem here to be on the confines of the organic and inorganic worlds. That the forces which govern both are identical, we are led, by the progress of science, each day to believe more strongly. That "vital force" itself will be found one day to be the simple result of more elementary forces—heat, light, and so forth—we can scarcely doubt. At present the term "vital force" is a mere cloak for our ignorance. To use the words of a contributor to the *Reader* (Oct. 29, 1864), "It is the compounding in the organic world of forces that belong equally to the inorganic that constitutes the mystery and the miracle of vitality. Every portion of every animal body may be reduced to purely inorganic matter. A perfect reversal of this process of reduction would carry us from the inorganic to the organic; and such a reversal is at least conceivable. The tendency of modern science is to break down the wall of partition between the organic and inorganic, and to reduce both to the operation of forces which are the same in kind, but whose combinations differ in complexity. The mode in which these combinations have been brought about is a perfectly legitimate subject of scientific speculation, and in this we will here so far indulge as to ask a single speculative question. It is generally supposed that our earth once belonged to the sun, from which it was detached in a molten condition. Hence arises the question, 'Did that incandescent world contain latent within itself the elements of life?' Or, supposing a planet carved from our present sun, and set spinning round him at the distance of our earth, would one of the consequences of its refrigeration be the development of organic forms? *Structural* forces certainly lie latent in the molten mass, whether or not those forces reach to the extent of forming a plant or an animal. All the marvels of crystalline force, all those wonderful branching frost-ferns which cover our window panes on a frosty morning, the exquisite molecular architecture which is now known to belong to the ice of our frozen lakes, all this 'constructiveness' lies latent in an amorphous drop of water, and comes into play when the water is sufficiently cooled. And who will set limits to the possible play of molecular forces in the cooling of a planet?" But even if we admit the soundness of these speculations, we must still look further backwards to "one Great First Cause," by whom are all things, and for whose pleasure "they are and were created."

NOTES ON SOME OF THE SMALLER RODENTS FOUND IN NORTH-WEST AMERICA.

(*Continued from No.* 36, *p.* 422.)

BY J. K. LORD, F.Z.S.,

Late Naturalist to the British North American Boundary Commission.

THE APLODONTIA LEPORINA (Rich.).

SEWELLEL OR SHOW'TL OF THE NESQUALLY INDIANS.

Synonymes.

Aplodontia leporina, Rich., F.B.A. i., 211, plate xviii.; And Bach. N. A., Qua. iii., 1853, 99, pl. cxxiii.
Hoplodon leporinus, Wagler System, Amh., 1830.
Anisonyx rufa, Rafinesque Am. Month. Mg. ii., 1817.
Arctomys rufa, Harlan F. Am. 1825, 308.
Sewellel, Lewis and Clark's Travels, ii. 1815, 176.

General Dimensions.—Nose to ear, 2 in. 7 lines; nose to eyes, 1 in. 5 lines; tail to end of vertebræ, 9 lines; tail to end of hair, 1 in. 2 lines; ear, height, 5 lines; nose to root of tail, 14 in. 6 lines.

My first introduction to this rare and curious little Rodent was on the bank of the Chilukweyuk river. My canvas house was pitched in a snug spot under the shade of a clump of cotton-wood trees, that grew close to a stream, that like liquid crystal, rippled past in countless channels, threading its way between massive boulders of syenite, and trap, and granite, and green-stone, that had been rounded and polished till they looked like giant marbles. But is not every one of these stones a silent record, a history in itself, of the terrible force of the summer floods? A few short months ago and this tranquil stream was a roaring muddy torrent, fed by melting snow. Endowed with freedom, what can resist the force of water? Rocks, and stones, and gravel, and mud, are dragged slowly along, grinding their predecessors as they go, until they come into the light again on the subsidence of the flood, and rest, as do these worn veterans, far from their mountain home.

Towering up behind me were the Cascade Mountains, their snow-clad summits dim in the haze of distance, their craggy slopes split into chasms and ravines, so deep, and dark, and lonesome, that no man's footfall has ever disturbed their solitudes; so densely wooded up to the very snow-line with pine, and cedar, and spruce-trees, that not even a bare rock peeped out to break the sombre monotony of the dark green foliage.

Before me, stretching away for about three miles, was

an open grassy prairie, one side of which was bounded by the Chilukweyuk river, the other by the mighty Fraser. At the junction of the two streams, at one angle of the prairie, stood an Indian village—the rude plank sheds and rush lodges, the white smoke curling gracefully up through the still atmosphere from many a lodge fire, the dusky forms of the savages, as they lolled and strolled about in the fitful light, gave life and character to a scene indescribably lovely.

The Chilukweyuk river heads from a large lake situated high up in the mountains, and without exception one of the most beautiful lakes I ever beheld. It is completely built in on all sides by vertical walls of trap and granite rock, and so precipitous and impassable, that when marking the boundary line, we were compelled to build scows, a rude kind of vessel, half raft, half boat, to cross over the mules, stores, and provisions, it being quite impracticable to make a road or trail on either side of the lake.

Filling up a gap between two rocky peaks is a vast glacier, that one might easily imagine a mass of brilliant beryl. The Indians say it was once another lake, but so many bad spirits lived in it, that Swa-nea, their grand saint, suddenly turned it into crystal, and all the wicked ones are shut up in it now. Numerous small streams trickle into the upper end of the lake, but the lower angle is dammed in by masses of rock, through which is a split or chasm, as if rent by some terrible force. Through this gap escapes the entire river; onward it goes, down the mountain gorge—leaping from rock to rock, it neither rests nor tarries in its headlong course, until stealing out from the dark shadow of the forest, it saunters idly along through the waving prairie grass, to mingle its waters with the Fraser, and with it to journey seawards.

The Indian summer was drawing to a close, the maple, the cotton-wood, and the hawthorn, fringing the winding water-ways, that, like silver cords intersected the prairie, had assumed their autumn tints, and, clad in browns and yellows, stood out in brilliant contrast to the green of the pine forest. The prairie looked bright and lovely, the grass, as yet untouched by the frost fairy's fingers, waved lazily, wild flowers of varied tints and species peeped out from their hiding-places, enjoying to the last the lingering summer.

I had been for some time sitting on a log admiring the sublime beauty of the scene spread out before me like a gorgeous picture, the sun was fast receding behind the hill-tops, the lengthening shadows were fading and growing dimly indistinct, the birds had settled down to sleep, and the busy hum of insect life was hushed. A death-like quiet steals over every thing in the wilderness as night comes on, a stillness that is

awful in its intensity, such as I have never realized but in the solitudes of an unsettled country. The sound of your own breathing, the crack of a branch, a stone suddenly rattling down the hill-side, the howl of the coyote, or the whoop of the night owl, seems all intensified to an unnatural loudness. I know of nothing more appalling to the lonely wanderer camping by himself than this "*jungle silence,*" that holds supremacy through the weary hours of the night.

This silence was suddenly broken, as was my reverie, by a sharp ringing whistle; it was so piercing and clear that I could not believe it was produced by an animal. It had hardly died away, when another whistler took it up, then a third, and so on until at least a dozen had joined in the chorus. I stole as carefully as I could in the direction from which the sounds came, but as I neared the spot the whistle ceased, and it was now far too dark to descry any object on the ground. So, in doubt, and sorely puzzled to account for such an unusual sound, and with a firm determination to unravel the mystery in the morning, I returned to my camp. Could it be Indians? No, impossible, there were far too many, and the tone of each whistle was precisely alike. I was equally sure it was not the cry of the rock whistler (*Actomys*), that sound I knew too well. What could it be?

As the grey light of the morning came peering into my tent, I started off to investigate the secret of the mysterious whistler; but all I could discover, after a long and diligent search, was, that there were numerous runs and burrows excavated in the sandy banks of the river, but by what sort of animal I could not for the life of me guess. Setting a steel trap at the entrance to one of the holes, I strolled down to the Indian village, thinking I should possibly be able to find out from the Red-skins what it was that made such shrill sounds. Partly by signs, and by using as much of their language as I at that time knew, I endeavoured to make the old chief comprehend my queries.

After attending to my frantic attempts to produce a ringing whistle by placing my fingers in my mouth, and blowing through them until my face was like an apoplectic coachman's, a smile of intelligence lit up his swarthy visage; then I set to violently digging imaginary holes, and explaining that the sounds came about twilight, he nodded his head, dived into the tent and disappeared in the smoke, but shortly emerged again with a rug or robe made from the skins of an animal that was quite new to me.

It was beautifully soft, glossy, brown. The skins were about the size of a large rat's, and about twenty in number. Here, then, was the dawn of a discovery. He called the animal

Ou-ka-la, and made me understand that it lived on roots and vegetable matter, and burrowed holes in the ground.

As the daylight faded out, I again took my seat, and just as before, when everything was silent, the woods echoed with the Ou-ka-la's cry. I longed for morning, and hardly waited for light, but hastened off to my trap, and, joy of joys, I had him sure enough, caught by the neck. Poor Ou-ka-la, your friends had heard, and you had given, your "last whistle." He was dead and cold, trapped, perhaps, whilst I listened, wondering, keeping my lonely vigil. A very brief examination revealed the fact that I had caught a magnificent specimen of the *Aplodontia leporina*, of which I had only read.

Captains Lewis and Clark obtained some vague information about this animal, which is given in their journal of travel *Across the Rocky Mountains*, in 1804. All they say of its habits is, "that it climbs trees and digs like a squirrel." They obtained no specimen of the animal, but saw, probably, robes made of the skins. It was subsequently described by Rafinesque, and by him named *Anisonyx rufa*, and by Harlan *Arctomys rufa*. In 1829 Sir John Richardson obtained a specimen, and after a careful anatomical examination, this eminent naturalist determined it to be a new genus, and re-named it generically and specifically. The generic name Aplodontia is founded on its having rootless molars, or grinding teeth, *απλοος*, *aploos*, simple; *οδους*, *odons*, a tooth. It belongs to the subfamily Castorinæ; dental formula $\frac{2}{2}$ $\frac{0\ 0}{0\ 0}$ $\frac{5\ 5}{4\ 4}$ 22.

Sp. ch.—Size that of a musk rat; tail very short, barely visible. Colour, glossy blackish brown. Male, length about 14 inches; female, resembling the male, but smaller. The fur is dense and woolly, with long bristly hairs thickly interspersed; the short fur is blueish grey at the base, the ends of the hairs being tipped with reddish brown; the bristles are black, and when smoothed give a lustrous appearance to the fur. The eyes are very small, and placed about midway between the nose and the ear. The whiskers, stiff and bristly, are much longer than the head, and dark grey. The ears are covered on both sides with fine soft hair, rounded, and very short, and not unlike the human ear in shape.

Skull.—The skull is much like that of the squirrel's, with the marked exception of having rootless molars, and the absence of post orbital processes; the occipital crest is well developed, the muzzle large, and nearly round. The bony orbits are largely developed; the auditory bullæ are small, but open at once into wide auditive tubes; the first molar is unusually small, oval, and situated against the antero-internal angle of the second; all the molars are rootless; the lower grinders are much like the upper, but somewhat longer and

narrower. The molars in both jaws are situated much further back than is usual; the centre of the skull being about opposite to the meeting of the second and third. The lower jaw is very singularly shaped, the inner edges of the molars on opposite sides being parallel; the descending ramus is bent, so as to be exactly horizontal behind; the postero-inferior edge, being a straight line, nearly perpendicular to the vertical plane of the skull's axis. The conformation of the incisor teeth is admirably adapted to the purposes they have to fulfil; no carpenter's gouging chisels are more effective tools than are these exquisitely constructed teeth. It is essential that they should always have a sharp, cutting edge, in order to nip through the tough vegetable fibre on which the animal subsists; at the same time strength and durability are indispensable. The Aplodontia has no whetstone, or quadrupedal razor-grinder, to sharpen his tools when they grow blunt; but an all-wise foreseeing Providence has so fashioned these wondrous chisels in all Rodents, that the more they are used the sharper they keep; the contrivance is as simple as it is beautiful. The substance of the tooth itself is composed of tough ivory, but plated on the outer surface with enamel as hard as steel. The ivory being the softer material of course wears away faster than the enamel, hence the latter, plating the front of the tooth, is always left with a sharp cutting edge. Where could we find a more striking evidence of design and forethought!

The position this genus should occupy in a systematic arrangement of the Rodents has always been a stumbling-block and a matter of doubt, in great measure attributable to the fact that but a single species of the genus is known, and very few specimens have hitherto been obtained. A fine male specimen has recently been set up in the British Museum collection, that I caught near my camp on the prairie.

In many particulars the Aplodontia very nearly resembles the Spermophiles, particularly the Prairie Dog (*Cynomys Ludovicciana*), but differs, as in the true squirrels, in the rootless molars and the absence of post orbital processes. In this respect it is allied to the beaver. It is quite impossible to assign it a well defined and settled position, until a greater number of specimens are procured, from which more minute and careful examination of the bony and internal anatomy can be made. At present, however, it would appear to connect the beavers with the squirrels, through the Spermophiles. All hitherto known about its habits is the quotation from the journal before mentioned.

The name Lewis and Clark gave this animal, *Sewellel,* is evidently a corruption of an Indian word. The Chinook Indians are a powerful tribe living near the mouth of the Columbia, and

from whom, in all probability, Lewis and Clark obtained the name, and first heard of the animal. But the Chinook name for the Aplodontia is Og-ool-lal, Shu-wal-lal being the name of the *robe* made from the skins; and this is unquestionably the word, corrupted into *Sewellel*, and misused as the name of the animal. In Puget's Sound the Nesqually Indians call it Show'tl; the Yakama Indians, Squal-lah; the Sumass, Su-ok-la.

A single glance at the conformation of the feet would at once convince the most careless observer that climbing trees was not a habit of the Aplodontia. The feet and claws are digging implements of the most finished and efficient kind; the long scoop-shaped nails, like garden trowels, wide strong foot, almost hand-like in its form, the strong, muscular arms, supported by powerful clavicles, proclaim him a miner; his mission is to burrow, and most ably he fulfils his destiny. His haunt is usually by the side of a stream, where the banks are sandy and the underbrush grows thickly, his favourite food being fine fibrous roots, and the rind of such as are too large and hard for his teeth. He spends his time in burrowing, not so much for shelter and concealment, as to supply himself with roots. He digs with great ease and rapidity, making a hole large enough for a man's arm to be inserted.

In making the tunnels he seldom burrows very far without coming to the surface and beginning a new one. Like a skilful workman, he knows how to economise labour; having to back the earth out of the mouth of the hole he is digging, the further he gets in the harder grows the toil, and so he digs up through, and starts afresh. They seldom come out in the daytime, and I have but rarely heard them whistle until everything was still, and the twilight merged into dark night.

The female has from four to six young at a birth, and they have about two litters in a year. The nest for the young is much like that of the rabbit, made of grass and leaves, and placed at the end of a deep burrow.

In the winter they only *partially* hybernate, frequently digging through the snow to eat the bark and lichen from the trees. Their gait when on the ground is very awkward, their broad, short feet are not fitted for progression, and they shamble rather than run, and can be easily overtaken. Where a colony of them has resided for any time, the ground becomes literally riddled with holes, and the trees and shrubs die for want of roots. I imagine, from having found abandoned villages, that they wisely migrate when their resources are exhausted. The Indians esteem their flesh a great luxury, and trap them in a kind of figure-of-four trap, set at the mouth of the burrows. I dare say they are as good as a rabbit; still, they have too rat-like

an appearance to possess any gastronomic attractions for me. Every one to his taste—*De gustibus non est disputandum.*

The Aplodontia has a terrible and untiring enemy in the badger (*Taxidea Americana*). He is always on the hunt for the poor little miner, and digs him out from his hiding places and devours him with as much gusto as the Indian. Its geographical range is not very extended, being, as far as I know, confined entirely to a small section of North-West America. I have seen it on the east and west slope of the Cascades, but not on the Rocky Mountains, although it very probably exists there. It is also found at Puget's Sound, Fort Steilacum, on the banks of the Sumass and Chilukweyuk rivers, West of the Cascades. On the Nachess Pass; at Astoria and the Dalls, on the Columbia. East of the Cascades.

I have thus endeavoured to jot down a few notes on the habits and localities of this curious Rodent. Feeding entirely on vegetable matter (for I never discovered a trace of insect or larvæ remains in its stomach), passing its life principally in dark burrows, and limited, as far as we at present know, to a very narrow section of a barren country, it is hard to imagine what purpose it serves in the great chain of nature, save it be that of supplying food to the badger, and both food and clothing to the savage; and yet we know that the all-wise Creator fashioned it, and gave it life, for some grand and specific purpose, if we could but read and rightly interpret the pages of nature's wondrous book. If we ask ourselves why was this or that made? how seldom can we, with all our boasted knowledge, answer the question. Why did He who made our world, the sun, and the stars, deck the butterfly's wing with tiny scales, that by a simple change in arrangement produce patterns beside which the most finished painting is a bungling daub? Why were those microscopic wonders, the diatoms and infusoria, formed with shells of purest flint, of the quaintest devices, but of mathematical correctness; atomies that fringe every frond of sea-weed, tenant every road-side pool, and are in countless millions in every berg and floe, that form banks hundreds of miles in length, and dance in myriad forms in every sunbeam? Why all the prodigal variety of strange forms crowding the sea—forms more wonderful than the poet's wildest dreams ever pictured. Who can tell? All mystery inexplicable; the further we wander into the enchanted labyrinth of life, the more we feel our own littleness, and learn this great truth, that all we see belongs not to us, but to One greater, and wiser, and holier; and amid all the stir, and hum, and bustle of nature's vast garden, in the babble of the brook, in the whisper of the breeze, we hear, as of old, "the word of the Lord God walking among the trees of the garden in the cool of the day."

ANIMALCULES IN THE WINTER.

BY PROFESSOR RYMER JONES, F.R.S.

It is but too generally taken for granted that during the winter months there is a suspension of activity in the world of animalcules, and we have not unfrequently heard our friends speak as hopelessly of obtaining Infusoria at Christmas for microscopical exhibition, as of gathering hedge-flowers and May-blossoms amid the snows of January. Indeed, were we to follow the directions usually given for their procurement, the one and the other would be equally unobtainable. Nevertheless, according to our own experience, winter is the very time for observing the infusorial races in their full luxuriance; at no other period of the year are certain forms of them so easily procurable. We well remember in our younger days sallying forth to Hampstead ponds or Blackheath, equipped with phials and ring-nets and dipping bottles *secundum artem*, and many a pleasant summer's day have we thus spent in vain endeavours to collect rare species, only obtainable, as we were then told to believe, in specified localities and at particular seasons. Experience has taught us better, and it will perhaps not only save our readers much valuable time, but ensure them a rich abundance of specimens of all kinds at any period, if they bear in mind the following circumstances in connexion with the natural history of the Infusoria generally. We have endeavoured to show in a former communication that infusorial animalcules are always to be found congregated in the vicinity of aquatic plants, many of them appearing to prefer certain forms of vegetation. It is not, however, with living, but with decaying vegetable matter that they are associated; it is upon the effete elements of plants that they feed, the rotting atoms just about to decompose afford them nourishment, they seize upon the macerated tissues of vegetables whilst they are still organic particles, and before they disband themselves into their component gases, restore them to the cycle of organized existences. Far from perishing with the plants upon which they seem to live, it is only by the death and decay of the vegetable world that they are called forth in full force and activity; and it is more especially during the winter, that is, when rotting leaves and decaying plants encumber the bottoms of our ponds, when the "fat weed" dissolves itself to slime, and the tissues of perishing vegetation are diffused through the mud and sediment of the pool, that they can be obtained in their greatest variety.

With this insight into the habits of the Infusoria, the micro-

scopist will find no difficulty in supplying his winter evenings with materials for observation. Furnished with an ordinary ring-net of muslin and a wide-mouthed bottle, he has only to proceed to the nearest pond (no matter if the ground be covered with snow, or the pond frozen over, so long as the ice is breakable) and there fish up from the bottom a few of the dead leaves, bits of pond-weeds or any similar remnants of vegetation, and having thus half filled his bottle with most worthless-looking scraps, let him fill it up with the pond water, and return in full confidence that he has not laboured in vain. Arrived at home, let him immediately procure three large tea-cups, into one of which, having well shaken his bottle, he must pour its fluid contents and allow it to stand for *one* minute, so that the thickest sediment may subside. At the end of *one* minute let him pour two thirds of the contents of the first cup into the second, and there allow it to stand for *two* minutes for the subsidence of its sediment, and then without delay, without shaking it, pour half of the contents of the second cup into the third. The cups may now be left to stand till the supra-natant water is clear, and the animalcules have all settled to the bottom.

On taking up with a dipping-tube a little of the sediment thus deposited, and submitting it to microscopical examination in a live-box, or upon a glass slide covered with a plate of thin glass, we have never yet been disappointed at the result. The sediment of our ponds and ditches seems indeed in winter time to be one vast nursery, in which are cradled all the families of microscopic life, the very metropolis of the race; and it is only by seeking them in this their retirement, that many interesting forms are obtainable with any degree of certainty.

Let us, however, place upon a slide a few drops of the deposit from our second tea-cup, procured, in the manner above described, from the Serpentine in Kensington Gardens, at this moment (January 2nd) partially frozen over, and covering them with a circle of thin glass, examine them with a ½-inch objective. The peculiar aspect of the contents of our slide, as compared with the well-known products of the pond in summer time, is at once strikingly evident—the colours of decay predominate throughout, all wears the livery of the sere and yellow leaf—the very Confervæ seem as if they had been bleached with chlorine, and a few ragged masses of semi-decomposed vegetable tissue tangled in slimy patches constitute, as a painter would say, the still life of the picture. And yet amid the desolation of the scene, the concourse of actors is quite as great as the dimensions of the stage will permit, and we at once perceive that a very pretty pantomime is in process of performance. *Naviculæ* of every form and size are

sailing in little fleets to all points of the compass. *Baccillariæ,* in sufficient diversity to satisfy Ehrenberg himself, are shooting forth their intersliding rods, or splitting themselves into all sorts of zig-zags. Various species of *Gomphonema, Echinella,* and *Cocconema,* borne upon thread-like stems, are conspicuously beautiful among hosts of *Diatoms* and *Desmideæ,* while here and there an isolated *Closterium* or *Micrasterias,* the only green objects in the wintry landscape, shine forth like little emeralds set in silver.

To those who are only familiar with the spring or summer scenery of the microscope, this almost total absence of green is a very remarkable feature; chlorophyll has evidently become a scarce article, and the whole tribe of vernal forms, so beautifully coloured by its presence, are here deficient. *Euglena, Astasia, Pandorina, et hoc genus omne,* are sought for in vain, although the *Volvoces* are represented by a pallid, unhealthy-looking specimen of *Sphærosira.*

The Rhizopods are few and far between, a single specimen of *Actinophrys sol* seeming to have become bewildered in the crowd. The ciliated Infusoria, as regards the number of individuals present upon the stage, are much fewer than would be met with in summer under the same circumstances—the transparent nymphs of the *corps de ballet,* with their bewildering maze of fantastic evolutions, have given place to less numerous, but more important-looking characters in the masquerade. *Trichodina,* under the aspect of a gold-fish globe of the clearest jelly, ornamented internally with coloured bonbons, is actively pirouetting with *Coleps,* in the shape of a drunken beer-barrel; while an animated plum-pudding (*Bursaria*), dances a Scotch reel with half-a-dozen *Cyclidia,* having very much the appearance of transparent mince-pies, during which evolutions various forms of *Leuccphrys* and *Paramecium,* easily recognizable as masters of the ceremonies, glide actively from place to place as if they were doing the polite to the whole party.

Nor are the Vorticellians to be omitted from our list of this goodly company. Of these, several beautiful arborescent forms (*Epistylis, Zoothamnium*) content themselves with gracefully bowing and curtseying to each other like belles of dignified deportment, while their brothers, *Vorticella cyathina,* much more jovially disposed, seem with uplifted glasses to be drinking to each other's health, until, unfortunately for them, just as they raise their wreathed cups for "one cheer more," a blue-looking Stentor (*Stentor cœruleus*) rushes right into the middle of them, upsetting the whole group, and raising such a commotion, that a dozen stewards of the ball might try in vain to re-arrange the dispersed dancers. Still, however, the

masquerade goes on with unabated spirit; a couple of water-bears, as they are well named by our German friends, or water sloths, as the French call them (*Tardigrada*), next enter upon the scene, looking for all the world like their quadrupedal namesakes, provided with a double set of legs, and, instead of toes, furnished with formidable-looking hooks, by the aid of which they rake and claw themselves into the middle of the motley assemblage with most unwieldy perseverance. In another part of the stage we see the empty skin of a Lynceus, in one corner of which a Swan animalcule (*Trachelocerca olor*) has ensconced himself, and where he seems to be amusing the company by enacting such a series of performances as we never before witnessed. It is difficult to say which is most wonderful, the amazing extensibility, flexibility, and contractility of his neck, or the activity with which he plies it in every possible, and apparently impossible, direction. Imagine a swan seated in one corner of the floor of a large drawing-room, suddenly shooting out its neck to the opposite corner of the ceiling, and from thence extending it along the whole length of one side of the room, like a great Plesiosaurus with a boa-constrictor for a neck, brandishing its head with the velocity of thought, and then in a moment shrinking to its natural dimensions. And now a grand turmoil announces the approach of another visitor; in rush the chariot-wheels of *Brachionus pala*, closely followed by one or two of his rotiferous brethren clearing away everything before them, tumbling the poor Swan animalcule and his fantoccini performance into a whole chaos of struggling atomies, and thus effectually stopping his indescribable exercise. No sooner have the Rotifers steamed out of sight than in glides a young *Planaria* clad in a coat of living velvet, the transparency of which permits you to admire the smallest details of his inmost structure. Not much lack of amusement here, we thought, as the departing skirts of the last arrival seemed to wave their adieux. What will come next? The question was at once answered by a lively little Naïs, whose black eyes suddenly peeped out from beneath a moving heap, from which she soon emerged, when, unfortunately, just as we were bringing her into focus, a couple of eel-lets (*Anguillula*), apparently feeling themselves incommoded by the crush, began to fight their way out of the crowd, and the curtain fell amid a scene of riot and confusion seldom witnessed within the walls of a theatre.

From the above list of the occupants of a single slide, which, however jokingly drawn up, is strictly accurate in its details, it will be perceived that, during the winter months, the animalcule inhabitants of the waters around us are by no means asleep. The Infusoria neither perish during the inclement

season, nor do they hybernate, but, on the contrary, are in a much better condition for microscopic observation than during the summer. The forms which chiefly occur are most of them of large dimensions, and living, as they appear to do, principally upon the transparent glair produced from decomposing vegetables, exhibit a clearness and translucency which is unusual at other seasons, and hence they may be fed with carmine or indigo under peculiarly favourable circumstances. In the Naïdes, the Planariæ, the Rotifera, and the Entomostraca, this glassy transparency is still more remarkable. Their alimentary canal appears completely emptied of all opaque particles, and their bodies are entirely destitute of oil globules, so that the details of their anatomy are traceable with extraordinary clearness, and moreover, the frequent occurrence among them of strange-looking creatures, evidently larval conditions of other forms of life, is well calculated to stimulate the curiosity of the observer whose time and opportunities permit him to enjoy the pleasure of watching their development.

DIFFRACTION EXPERIMENTS.

THERE are no experiments in optics more brilliant and beautiful than those which illustrate the effects produced by what is called the Diffraction of Light, a term which etymologically indicates a bending of the rays out of their course, and also a certain division or separation of them. The name is not perhaps very happily chosen, and M. Babinet in explaining certain phenomena of diffraction uses the term *paragenie,* or lateral propagation. The precise nature of the action that takes place in cases of diffraction can only be understood by those who are capable of following the mathematical illustrations given in such works as Sir John Herschel's *Treatise on Light.* It is, however, possible to explain enough of the matter to give the general reader a notion of the subject, correct as far as it goes, and which, without attempting to elucidate the intricacies of the question, will augment the interest to be derived from contemplating a series of easily obtained and splendid effects.

First, let us take from Sir J. Herschel a diagram showing what occurs when a ray of light strikes against the edge of an opaque object, and also quote from him a passage describing the action. He says: "When an object is placed in a very small beam of light, or in the cone of rays diverging from an extremely small point, such as a sunbeam admitted through a

pin-hole into a dark chamber, or, still better, through an opening of greater size, behind which a lens of short focus is placed so as to form an extremely minute and brilliant image of the sun, from which rays diverge in all directions, its shadow is observed to be bordered externally by a series of coloured fringes, which are more distinct the smaller the angular diameter of the luminous point, as seen from the object. . . . To see the fringes in question, they may be received on a smooth white surface." M. Fresnel, Sir John tells us, first used an emeried glass plate to receive the fringes, and looked at them through it from behind. He then found that when he had focussed them with a magnifier they continued visible, as if drawn on the air, when the plate was removed. The first thing to be noticed is "that the distance (of the fringes) from each other, and from the border of the shadow, diminishes as the screen on which they are received approaches the border of the opaque body, and ultimately coincides with it." The second important thing to be noticed is, "That they are not propagated in straight lines from the edge of the body to a distance, but in hyperbolic curves, having their vertices at that edge, and therefore it is not *one and the same* light which forms one and the same fringe at all distances from the opaque body." In the diagram subjoined, Fig. 1, "O is the luminous point, A the edge of the (opaque) body, and G H a screen perpendicular to the straight line O A; C the border of the visible shadow, and D, E, F, the places of the successive minima of the fringes in a line at right angles to the edge of the shadow. If the screen be brought nearer to A as at *g h*, and if *c, d, e, f*, be the points corresponding to C, D, E, F, their loci will be the hyperbolas A*c* C, A*d* D," etc. The diagram shows that the rays behave as if they were so repelled from A as to oblige them to continue their path in a curve instead of going straight on from A to B. The result of this is that shadows are seen where they would not occur if the light did move quite straight from A to B. "Newton found the shadow of a hair, $\frac{1}{280}$th of an inch in diameter, placed at twelve feet distance from the luminous point, to measure at four inches from the hair $\frac{1}{60}$th of an inch, or upwards of four diameters of the hair, at two feet $\frac{1}{28}$th of an inch, or ten diameters, while at ten feet it measured only $\frac{1}{8}$th of an inch, or thirty-five diameters, instead of 120, which it would have done if the rays terminating the shadow had proceeded in straight lines, or rather, to speak more correctly, if the shadow were

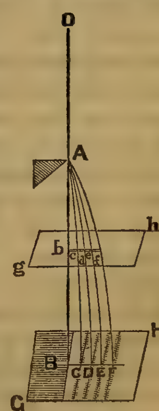


FIG: 1.

bounded by straight lines"* The investigations of Fresnel show that a strict application of the undulatory doctrine of light, assisted by the principle of interferences, will be found to afford a full and precise explanation of all the facts, regarding the opaque body merely as an obstacle *bounding* the waves propagated from the luminous point on one side."†

Let us now endeavour by appropriate analogies to obtain an elementary conception of light as a system of vibrations of a subtle fluid, or ether, and therefore bearing a certain resemblance to sound, or to water waves. It is easy to realize the fact that sound consists in vibrations and waves of air. The large strings of a harp or guitar may be seen to move when agitated so as to produce sounds, and various contrivances have been devised to make phenomena of this kind strikingly appreciable by the eye. When a stone is thrown into a still pond we have another illustration of wave forms, and we see them propagated in all directions, in circles increasing in dimensions, until the margin is reached. The most violent of these waves are those nearest to the stone causing the disturbance, and as they grow wider and act upon a greater breadth of water, they grow feebler likewise, until at last, if the pond be big enough, they die away in ripples too faint for observation. If, after we have set one series of waves in action, we start another with a different velocity, it will happen that some of the hollows of the first set will coincide more or less completely with the elevations of the second set; and when this occurs, a more or less perfect calm ensues, while the addition of hollow to hollow, or crest to crest, deepens the disturbance, and magnifies the miniature storm. If waves of sound are started one after another in due proportion, or if two sound waves, with just the right difference between them, be started together, this process of partial filling each other up may be produced, and at certain points of the wave march, corresponding with definite intervals of time, silence will result from the concurrence of two sounds. If at certain intervals the hollow of one wave is exactly filled up by the crest of another, no sound will be heard; but a partial filling up will modify the sound, and make it yield a different note. Much of the art of music consists in the production of well-managed interferences, giving rise to varied and highly pleasing effects.

If we pass from sound to light, we find ourselves able to produce bands of darkness by the interference of two rays of light. We can also devise methods of interference that shall give rise to modified waves having the dimensions necessary to excite upon our eyes the effects belonging to all the

* Sir J. Herschel's *Treatise on Light*, p. 480. † P. 481.

colours that we can see. The beautiful prismatic and other colours, to be obtained by means of the polariscope, and various bodies with which the microscopist is acquainted, are illustrations of one mode of obtaining chromatic effects by the interference of rays of white light. They depend upon refraction, and upon the path polarized light is able to take through crystals and other substances capable of affecting its velocity. Certain rays are bent out of their course, they are also more or less *dispersed*,* or resolved into prismatic rays, and these rays caused by further refraction to meet in certain directions, and with certain velocities, interfere with each other, and make the gorgeous colour pictures in which the microscopist delights.

If we can obtain interference of rays by any other means, we shall produce dark bands, or coloured bands, according to the circumstances of the case.

The extreme red ray of the solar spectrum is produced by undulations so numerous that, according to tables given by Sir J. Herschel, 37,640 of them only occupy one inch, and 458,000,000,000,000 occur in one second. These rays are, however, large in the length of their undulations, and slow in their movements compared with those of the extreme violet end of the spectrum, in which 59,750 undulations only occupy one inch, and take place at the rate of 727,000,000,000,000 in one second of time.†

Bearing in mind these considerations, let us now borrow another diagram from Sir J. Herschel to show a simple case of interference resulting from a wave of light being partially obstructed by a narrow opaque body. O, Fig. 2, is a needle-hole, through which a small sunbeam is allowed to pass; A B is a strip of card, which, in the experiment performed by Dr. Young, was $\frac{1}{30}$th of an inch wide; E F, its shadow. Let the reader forget for a moment the obstacle C D, which is wanted for a subsequent experiment. A B will then be the only obstacle in the way of light getting from O to any point between E and F. If we take the centre, X, it will be plain that the light that reaches it will result from the spreading portions of the wave passing the points A and B, and as each extends laterally, they will meet at X with equal velocities,

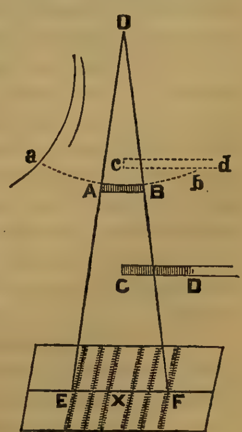


FIG: 2.

* See paper on "Spectroscope Apparatus," No. 34.

† These numbers will be slightly altered by the last estimation of the velocity of light.

and having made their journeys in precisely the same time; but undulations extending from F towards E will meet other undulations that started at the same time, but reached E quicker than those that came round the other corner. These will interfere and give rise to dark or coloured bands, according as their interference is complete or only partial. Dr. Young introduced the screen C D to cut off the undulations that passed B, and by so doing he stopped the interferences, and no fringes appeared.

We have thus arrived at a general explanation of why dark lines appear when white light is viewed through a very narrow slit, cut in a piece of metal or card.

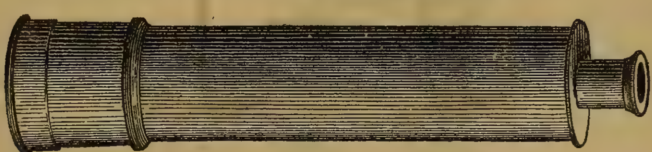
If, instead of such a slit, we obtain a piece of glass ruled with fine lines, a five hundredth or a thousandth of an inch apart, the flame of a candle seen through them offers a splendid spectacle. A glass of this description, ruled very beautifully by Messrs. Horne and Thornthwaite, is in our hands at this moment; we hold it near the eye, so that the lines are vertical, and look at a candle-flame a few feet off, or at the sky in the day time. The candle-flame is seen in its natural colour in the centre, then on each side of it a dark space, and after that, in succession, right and left, a number of images of the flame in prismatic colours, the reds being always furthest from the central flame, and the blues nearest to it. The first few of these coloured images of the candle-flame are separated by considerable though lessening dark spaces from each other, and they are followed by numerous other images, running together, and forming a beautiful spindle-shaped pattern of variegated light. If we turn the ruled glass round, so that the lines are *horizontal* instead of vertical, the candle-flame gives us a continuous spindle of light, in which the several images of the flame run into each other. The optical effect is as if a number of coloured candle-flames were all fixed to a sort of a windmill arm and rotated about on a central axis, and at the same time each flame rotated about its long axis, so that whereas, at the beginning of the experiment, we saw its breadth and depth from top to bottom, at the end we see little more than the tips of the flames.

The effect varies according to the distance of the candle-flame from the ruled glass. Close to the flame the coloured images are confused, near each other, and deficient in brilliancy. As the spectator (carrying the ruled glass with him) recedes from the flame, the coloured images grow brighter, and separate from each other, and after they are thus separated, to a certain extent, revolving the ruled glass ceases to change the *form* of the pattern, as just described, and merely causes the spindle of coloured light to revolve. Eight and twenty feet off

a candle-flame, we see, with the particular ruled glass employed, a luminous coloured spindle about eight feet long.

For the next experiment we take a piece of blackened card and cut a thin slit in it. We hold this in one hand near the candle, and look at the light through the ruled glass, with the lines and slit both *vertical*. We have now an exquisite ribbon, composed of dark spaces and coloured light spaces arranged as before. If we keep the ruled lines in this position, the diffraction light ribbon will be at right angles to them, and as we revolve the slit, the ribbon will seem to turn so as to present itself alternately edgewise and full front. If we keep the slit still, and revolve the ruled lines, the ribbon of parti-coloured light will appear to experience two motions: one round and round, like a windmill arm, and the other the kind of revolution just described, giving us sometimes an edge view and sometimes a full view of the coloured stripes.

Mr. Slack has devised a very simple apparatus, the "Diffraction Kaleidoscope," manufactured by Messrs. Horne and Thornthwaite, which will enable a number of brilliant experiments of this kind (including many originally performed by Frauenhofer) to be made at the very moderate cost of purchasing the instrument, and without any trouble.

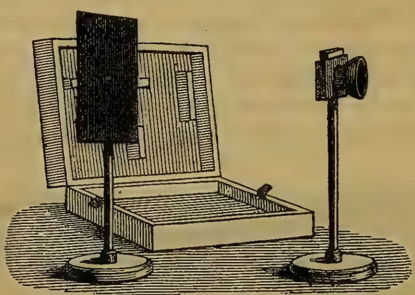


THE DIFFRACTION KALEIDOSCOPE.

The Diffraction Kaleidoscope consists of a tube, at one end of which is a revolving eye-piece, and at the other a revolving holder of discs of blackened card having certain apertures through which light is permitted to enter. The experiments just mentioned may be best performed by this instrument. A card disc with one pin-hole in the centre is placed in the disc holder, and an eye-piece containing a "grating" or ruled glass is slipped on to the opposite end of the tube. On looking through this at a bright light, obtained in the daytime from the sun or sky, and at night from any good lamp, effects like those just alluded to as seen with candle flame, may be observed. After witnessing the actions of one "grating," and one source of light, a second grating may be imposed over the first and at right angles to it. A brilliant chromatic star will then appear, with four principal rays, and other intermediate rays, which become conspicuous in proportion to the brightness of the light. The

second grating should then be removed and the effect of the *slit-disc* observed, first with one and then with two gratings. By holding the tube in the middle, either the eye-piece or the disc holder may be rotated separately as desired.

If a disc pierced with symmetrically-arranged holes in a circle about the size of a shilling, is employed, a very striking effect of perspective is noticed. The holes are really in one plane at right angles to the eye of the spectator; but when one grating is employed, each hole is seen in the centre of a spindle of many coloured light, and all the spindles seem arranged on a *horizontal cylinder,* so that when one of them looks exactly before the eye, and near it, another seems precisely behind the first and farther off. As the disc holder is rotated, the cylinder of spindles revolves, each spindle alternately approaching and receding from the eye. When one spindle looks exactly behind another, it is impossible to avoid the illusion that its light is



A. Holder for ruled glass, etc. B. Screen. C. Box holding apparatus.

literally seen through the light of the other. A singularly beautiful addition to the effect is obtained by the use of the second "grating" at right angles to the first. The rotation of the disc holder then gives the spectacle of two cylinders of spindles rotating at right angles to each other, and crossing their lines of light in a magical way.

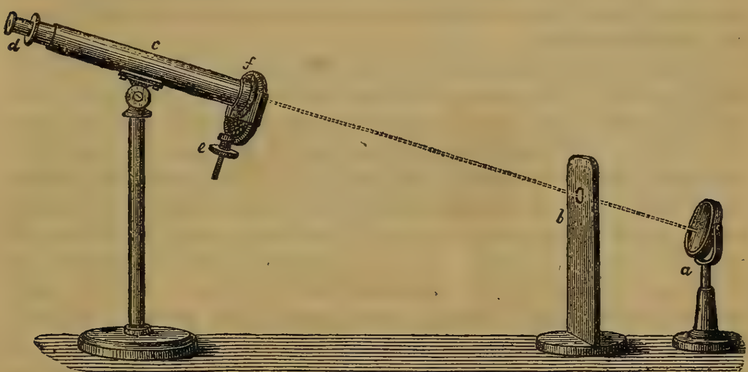
Instead of the disc of pin-holes in a circle, another disc with a large central hole and smaller ones removed from it may be used. This planet and satellite disc is very fine in its effects, especially when the slender light spindles afforded by the small holes appear to be behind and seen through the big spindle which the large hole gives rise to. Holes arranged in a triangle are likewise interesting; but any one who possesses the "Diffraction Kaleidoscope" can vary the patterns of the discs with no more trouble than piercing some discs of blackened card.

When the disc with pin-holes in a circle is used with two

"gratings," the revolutions of both gratings (without changing their relative position to each other) gives the appearance of double motion in each cylinder of light spindles; but if the outer grating is revolved while the inner one is stationary, one cylinder of spindles remains fixed and the other goes round.

Some experiments with gratings require the power of varying the distance of the source of light. For these Messrs. Horne and Thornthwaite have arranged a commodious apparatus, as shown in the cut on the preceding page.

The next apparatus for diffraction experiments which we shall describe, is the beautiful one exhibited at the scientific soirées of last season, by Messrs. Horne and Thornthwaite, and to which allusion was made at the time. This consists of a small telescope mounted on a stand.



BRIDGE'S DIFFRACTION APPARATUS.

The object-glass is covered by an apparatus devised by Mr. Bridge, by means of which a disc of glass, on which a multitude of diffraction patterns are photographed, is made to revolve in a spiral, so that all the patterns in succession, from the centre to the circumference of the disc, can be brought into the field. The exquisite patterns of these discs were drawn and arranged by Mr. Bridge, and they offer a great variety of different curves, chequers, etc., etc. When the sun is shining, magical and lustrous chromatic effects are obtained by placing on a table or other stand, a dark screen, in the centre of which is a lens of short focus. A mirror behind the screen receives the direct sunlight and directs it upon the lens, as shown in the sketch. An observer a few feet off in front of the lens sees a most brilliant spot of intense light, and if this is focussed by the telescope, and the diffraction disc revolved, a succession of gorgeous effects delights the eye. Stars of greater or less complication, lines of parti-coloured

light in beautiful curves and angles appear in succession, and the astonishment is great to notice what kind of diffraction grating gives rise to such unexpected effects. If the principles explained at the commencement of this article have been apprehended, some notion may be formed of the way in which each dark space of a grating may be the occasion of interferences between waves of light spreading laterally and meeting with other waves that have traversed longer or shorter paths.

To use Mr. Bridge's apparatus at night, an electric or oxy-hydrogen lamp is necessary to develope the full splendour of the effects. If magnesium wire becomes cheap enough, it would do admirably, and be always ready. Some notion, though a feeble one, may be gained by the employment of an ordinary lamp; but those who have not the command of powerful sources of artificial illumination must be content to experiment on sunshiny days.

Some pleasing and instructive effects can be produced by placing a photographed diffraction pattern near the eye at one end of a tube, and at the other a stop with a small central hole, or a slit, or a plurality of holes, arranged in a pattern such as a triangle, or as the shape of an italic *S*. The gorgeous colours do not appear in these experiments, and the pattern seen by the eye is much simpler than when the telescope and night source of light are employed. It is, however, well to study the difference of the effects produced by the two methods, and Messrs. Horne and Thornthwaite supply the means to those who require it. If a photographed diffraction pattern is placed at the eye end of a microscope tube, the small stop of an achromatic condenser will do for a source of illumination at the bottom.

Mr. Bridge's apparatus gives the most splendid appearances when a sufficiently brilliant light can be obtained. The "Diffraction Kaleidoscope" has the advantage, that for its very important though more limited operations, it is always ready, and, like the ordinary Kaleidoscope, may be passed from hand to hand and pointed without trouble at any ordinary source of light. Other experiments are conveniently performed by aid of the other apparatus figured above.

MR. LASSELL AT MALTA.

Mr. Lassell has addressed a letter to the *Astronomische Nachrichten,* giving some account of his proceedings at Malta during the term of a three years' residence now drawing to a close. He describes his telescope—a Newtonian reflector—as mounted equatorially, in a manner generally resembling that on which his 9-inch and 2-feet telescopes were mounted, as described in the *Memoirs* of the Astronomical Society. "The aperture is nearly 4 feet. There are two large specula, respectively of the foci of 441·8 and 448·1 inches. They are about 4½ inches thick, and weigh separately about 2700 lbs. The length of the tube is 37 feet, and its diameter 4 feet 3 inches. It is a lattice or skeleton tube, made of flat bars of iron, joined (with spaces between them nearly equal to the breadth of the bars) by flange rings at convenient distances." The object of this construction is to avoid chimney currents in the tube. No roof covers the telescope; but the observer is placed in a tower, one or other of whose stories commands the eye-piece at any elevation required. The stories of the tower are 4½ feet square and reached by an internal staircase. The tower itself is carried round by a circular railway. It can also revolve on its own axis, and it has a radial motion to or from the telescope.

Instead of a driving clock, which Mr. Lassell considered would be inconvenient from the great weight of the apparatus, he has a system of wheel-work terminating in a fly-wheel and winch handle. By turning the latter exactly once in a second, any object is kept in the field, and a peasant can do this by accommodating his movements to the indications of a loud ticking clock. This motion can be stopped, accelerated, or retarded at pleasure, and not being at all laborious, "can be continued for hours without being oppressive."

"Attached to the regulating clock are two dials, the finger or index of one of them having a retrograde motion and the dial figured accordingly; while the other is direct. The first of course belongs to the eastern hour angle, which is constantly diminishing—the second to the western. Being set to the present hour angle at the commencement by the observer, if from clouds, or any other cause, the observation is interrupted, the assistant can, by mere inspection of the dial, bring up the telescope to correspond with it by another winch having a quick motion, without the observer having to descend from the tower, or interfere in any way."

Among the planets, Neptune has received Mr. Lassell's special attention, and he says "the known satellite is so well

seen, especially when more than 8 or 9 seconds central distance from the planet, even in bright moonlight, and without any extraordinary atmospherical circumstances, that I have arrived at the firm conviction that the planet is attended by no other satellite which will bear comparison in magnitude with the known one—not greater certainly than Dione or Rhea, among Saturn's satellites, bears to Titan. It may be indeed possible that a faint satellite several minutes' distant might exist, though I have no suspicion of any, and one so situated would be very difficult to recognise among the numerous minute stars which a telescope so large as this generally reveals."

Equally careful observations were made on Uranus, confirming the belief that this planet only possesses the two satellites first discovered by Sir William Herschel, and the others (interior) discovered by Mr. Lassell in 1851.

Mr. Lassell considers that "in all future treatises on Astronomy, the proper number of known satellites should be assigned to these two planets—namely to Uranus four, and to Neptune one."

To facilitate observations on Saturn, Mr. Lassell appends to his letter an Ephemeris of the five inner satellites of Saturn for February, March, and April, 1865.

A series of drawings of Mars during his late opposition was much interrupted, as the weather for two months (November and December) was "quite as unfavourable as it is usually in England at the same season."

A good many drawings have been made of remarkable nebulæ, including an elaborate one not yet finished of the great nebulæ in Orion.

ASTRONOMICAL NOTES.

BY THE REV. T. W. WEBB, M.A., F.R.A.S.

THE GREAT STAR OF 1572.

No one can peruse the account given of the Temporary Star of 1572 without a conviction that it was one of the most marvellous phenomena which the Creator has ever exhibited to the eyes of men. Its sudden apparition; its astonishing splendour, rivalling, in the opinion of Tycho Brahe, Venus at her maximum, and rendering it visible even at noon-day, and that at a period when there were no telescopes to point to its place, after the mode practised by Schmidt in our own days; its visibility to all eyes during seventeen months, precluding the possibility of deception; its invariable position with regard to the neighbouring stars, proving that, if not equally distant with them, it was far removed beyond the bounds of the solar system; its scintillating aspect, indicating, in all probability, the smallness of its apparent disc, and its community of nature with other stars; its change of colour corresponding with its regular decrease in magnitude—all these combine to place it in the highest rank of celestial wonders. And time, that has done so much to throw light upon other difficulties, has brought none to this. It is now indeed known that the phenomenon, though extremely rare, is not unique; twenty-one instances of temporary, as distinguished from periodically-variable stars, having been collected by the industry of Humboldt. These are chiefly from the Chinese record of Ma-tuan-lin; and some of them appear to rest on no good authority; but there can be no question as to the splendid star seen by Kepler in 1604, which almost equalled, and in the opinion of some surpassed, that of 1572, or that discovered by Hind in 1848, which, though far inferior in magnitude, exhibited the same character. It has, too, been suspected that such phenomena are periodical, and, if so, may be looked upon as extreme cases of variable light. The chief ground for this idea is the statement that new stars are said to have appeared in the years 945 and 1264 "between Cepheus and Cassiopea," a description which, allowing for the inaccuracy of ancient chronicles, might pass for the position of that in 1572; nor would the inequality of interval be a sufficient bar to the supposition, as similar irregularities are constantly occurring in the periods of variable stars. If this could be admitted, and a period of something more than 300 years be reckoned upon, it is plain that observers ought to be now on the look-out for its possible return. With this impression, Professor Argelander, of Bonn, one of the very

highest authorities in stellar astronomy, has recently directed attention to the subject. Forty years back he undertook an elaborate computation of its place from the measures of Tycho, which were taken with a sextant from eight neighbouring stars in Cassiopea. These, as compared with the observations of Bradley, W. Struve, Bessel, and Piazzi, give an average error of + 1m. 26s. in R.A., and — 13″ in Decl., an amount by no means discreditable to an instrument of comparatively rude construction, and employed only with the naked eye. Its place thus deduced will be, for 1865, R.A. 4h. 19m. 57·7s.—D.N. 63° 23′ 55″·4. Our own great computer Hind had found a result 3m. 10s. less in R.A., and 50″ less in Decl., a difference the cause of which could not be ascertained by Argelander without a fuller explanation of Hind's mode of procedure. But assuming the place as calculated by himself, Argelander remarks that D'Arrest has observed a star, numbered by him 129, so nearly in the right position (that is, R.A. 4h. 19m. 30s., D.N. 63° 22′·9), that the difference does not exceed the uncertainty of the old observations. This, of course, would not be surprising amid the richness of the starry heavens; but what has struck Argelander has been the circumstance that he had formerly, with the 8-foot transit-instrument at Abo, sought in vain for a star near this place, as well as subsequently (probably in 1849) with the meridian instrument at Bonn; and the question has arisen in his mind whether D'Arrest's star, estimated by him as of 10·11 magnitude, may possibly be that most wonderful phenomenon in a slowly-increasing stage. He therefore entreats astronomers, who may possess sufficiently powerful means, to keep watch upon this little star. It may be added that the sudden development of the phenomenon of 1572 (as well as of those of 1604 and 1848) furnishes no serious argument against its periodical character, for a great disproportion between the times of increase and decrease is not unfrequently associated with variable light, and in those less observant days the earlier stages of its visibility would naturally escape notice, till it became too conspicuous to be any longer overlooked. It is not impossible that the parallax and distance of this wonderful star might have fallen within the grasp of such instruments as we now possess; and it might even have exhibited a visible and measurable disc, though this is less probable from what is recorded as to the intensity of its scintillation. But should any recurrent or fresh development of this kind take place during the present generation, we may be sure that the spectroscope of Mr. Huggins will be tasked to the uttermost to ascertain its real character.

TWILIGHT.

The well-known director of the Athens Observatory, Dr. J. F. Julius Schmidt, has published a valuable memoir on the duration of twilight, and inquiries of a kindred nature. The paper is a long one, and full of laborious computations; but some of his conclusions possess considerable interest as well as novelty. The subject, which has been very little explored, and has received little illustration since the imperfect observations of Ptolemy and Alhazen, had attracted his attention for twenty years, but his experimental investigations date chiefly from February, 1856. His observations, which were very numerous, were spread over a zone reaching from N. lat. 53°·5 to 36°·5, but were chiefly made at Olmütz, in Germany (N. lat. 49° 35′·7), and Athens (N. lat. 37° 58′·3), where the purity of the sky afforded far greater facility, and where the subject was still further pressed upon his notice by a request from the Athenian Bürgermeister in connection with the lighting of the town by gas! (What would have been the astonishment of Pericles!) His memoir does not, however, treat of the termination of ordinary or civic twilight, when 6-mag. stars first become visible in the zenith, but of that of astronomical twilight, when the last trace of light vanishes from the horizon, the real night begins, and the sky over the coasts of the Mediterranean is granulated or powdered over with innumerable glimpses of stars of the 6 and 7 mag., too minute to be fixed by the eye. His observations were always made on the zenith, under which term he obviously includes a considerable extent of sky; and his conclusions affect not merely the maxima and minima of duration, but the height of the atmosphere, as far as its existence is thus rendered perceptible. He marked, of course, the progress of twilight by the successive appearance of stars of the first 6 mags.; but, by the term 1st mag. stars, he designates, otherwise than is usually done, the exceptionally bright ones, Wega and Capella, Sirius culminating too low at Olmütz on a lighter background, and Arcturus, though sometimes employed, being suspected by him of slowly variable light. How he classed the smaller stars, commonly reckoned as of 1st mag., does not appear. These great leaders, if watched for in the ordinary way, he thinks might be detected from 18m. to 70m. (probably a misprint for 20m.) after sunset; but if due preparation were made, by first finding the star in a telescope, and then looking along the outside of the tube as a guide, he found that stars of this brilliancy would come out very much earlier, though the practice was so trying to the sight that his results were not numerous. They are, however, very curious. He found that these large stars, thus hunted

out, became visible to the naked eye even before sunset. Sirius, for the reason given above, he thus saw only seven times; but another of his 1st mag. stars, when near the zenith (he does not specify which, but from the date, June, it must have been Arcturus), he actually perceived 24m. *before sunset,* and gives as the mean of such observations by a practised eye, 8m., when the centre of the sun is still 40′ above the horizon.* As to the smaller stars, he found that, at a mean, the sun's centre must sink respectively beneath it to 4° 18′, 5° 4′, 6° 50′, 8° 52′, and 11° 39′, in order to admit of those of the 2, 3, 4, 5, and 6 mags. becoming visible; a much smaller estimate, by 6° at an average, than that given by Wurm at the beginning of this century. The final extinction of horizontal twilight was not observed at Olmütz from the extreme rarity of suitable opportunities: at Athens its frequent observation presented no difficulty on that score, but was not easily accomplished, from a very different reason—the interference of the Zodiacal light, which is there never absent from the morning or evening sky, and disturbs the observation in different degrees, according to its varying brightness and inclination to the horizon at different times of year. It appears that the old observers could not have been misled by the presence of this phenomenon, from the very fair value, 18°, which they have assigned for the sun's depression at the end of twilight; but he justly thinks it extraordinary, considering the brightness and singularity of the appearance, that it should have been mentioned by no one before Cassini,† and conjectures that in old times it must have been either less brilliant, or else so familiarly known in more southern countries that no especial notice was taken of it. At the final close of twilight he found the depression of the sun beneath the horizon of Athens, Dec.

* The old story of seeing stars in the day-time from the bottoms of wells or pits is fully authenticated. I believe I have met with an account, which I cannot now verify, of Sirius having been traced for some time after sunrise by an old observer, probably Hevel. More to the purpose is Bond's statement, that he actually saw that star on one occasion when "the sun was high above the horizon and shining clearly;" and he adds, "from the readiness with which the latter could be discerned, in a position where much of its light must have been lost by atmospheric extinction, I should think it possible to see *α Lyræ* also under favourable circumstances."

† Who was the first discoverer of this phenomenon, the mystery of which seems to become more and more impenetrable, or rather, who first drew attention to it, seems uncertain. It has been said, but I know not on what ground, that Kepler has mentioned it. It appears from Hooke's Lecture on this "Glade of Light," read before the Royal Society, June 3, 1685, that Dr. Childrey's observation upon it, published in 1660, "was translated into *French,* and printed in the year 1667, as appears by the *Miscellanea Curiosa Academiæ Naturæ Curiosorum;*" and by that means the Advertisement was spread in *France* and the rest of *Europe.* Cassini, however, published his own observation of it in 1683 as an original discovery, and his high character affords a fair presumption that to the best of his knowledge it was so.

1st = 17°·7; June 1st or July 1st = 15°·3, and at a mean of the whole year, = 15°·92. His observations at Olmütz, though too incomplete to give anything like accurate results, sufficiently show that there are two *maxima* for the duration of twilight, corresponding with summer and winter, and two *minima*, in spring and autumn. The longest mean monthly interval between sunset and the appearing of the minutest stars was 106·3 minutes, occurring in June; the shortest, in January, 69·5 min. Similar *maxima* and *minima* were found to exist at Athens; the longest interval being, however, only 99·2 min., owing to the difference of latitude. He adopts Bauernfeind's recent value of the horizontal refraction, 34′·3, as more accurate than the formerly received one, 36′. The diminution of starlight from passing through the atmosphere, like that of the blue colour of the sky, he considered imperceptible as far as 50° or 60° from the zenith; but on the shores and islands of the Mediterranean days occur in which the blue tint reaches so completely down to the sea line that it is difficult to convince ourselves that the tone of the zenith is a little deeper; nights, too, when the stars preserve their brilliancy to 10° or 8° from the horizon. In the most transparent nights of Attica, he found that Jupiter, even when 86°·07 from the zenith, rivalled Wega overhead, and Arcturus had sunk to 82°·3 before it was reduced to equality with *a* Cygni near the zenith. His comparative values, taken at Olmütz, gave for the brightness of Jupiter 45·2; for Wega or Capella, 38·7; for Arcturus 36·1. From the habit of such investigations, when first he caught sight of Canopus, the glory of those skies which we never see, deep on the sea-horizon of the Isle of Cerigo, he concluded that it would at the zenith have exceeded Wega by two or three of the units of his scale. How that scale was constructed, he has not here given us any information.

From these researches, combined with barometrical and thermometrical investigations, Schmidt has deduced the height of the atmosphere, as far as it is made known to us by its action upon light, equal to 46 miles at Athens on January 1, decreasing, though not quite regularly, to 35 miles on June 1 and July 1. These values, he thinks, may probably have been augmented by refraction beyond their true amount; and he intends to prosecute the subject further. It is obvious that these inquiries must be materially affected by transparency of sky and keenness of vision; and when we find that within the "square" of Pegasus, Schmidt could count with the naked eye 102 stars at Athens, while Argelander at Bonn could detect barely 30, we may form some idea both of the extraordinary facilities afforded by the Southern heavens, and of the difficulty

of combining the observations which they yield so readily with those which are reluctantly given up by our more turbid skies.

SOLAR OBSERVATION.

But a few years ago it would have been difficult to realize the idea of a light exceeding the brightness of the sun. Its possibility must of course be conceded; but all experience was against its existence, excepting during the suspension of the ordinary laws of nature. The "Carrington-Hodgson" observation of Sept. 1, 1859, was the first to dispel this erroneous impression in the most effectual manner, by exhibiting a burst of yet more vivid flame even in front of the glowing solar photosphere: but this evidence no longer stands alone. Mr. Brodie informs us that he was permitted to witness a second phenomenon of this nature on the morning of last Oct. 2, in the form of a very brilliant body about 4″ or 5″ in diameter, "its light far surpassing in intensity that of the Sun's photosphere," into which it seemed to fall after a course of about 1′ performed in 0·3s. His sketch exhibits a slightly curved tail, which seems to have been identical with its line of flight, but has "two very considerable 'serrations' on its eastern edge." This recurrence of a most interesting, and till recently quite unsuspected phenomenon, ought to put all solar observers especially on their guard, to be prepared to catch and to record these fleeting manifestations of one of the great energies of this wonderful creation.

OPTICAL DECEPTION.

In the INTELLECTUAL OBSERVER for October, 1863, an account was given of an atmospheric illusion, by which the telescopic images of the stars were doubled. A similar deception was noticed on Jan. 21 of the present year. Orion, ascending to the meridian in the S.S.E., was found studded with double stars. *Betelgeuse* and *Rigel* were turned into splendid pairs, each having acquired a companion of the 4 or 5 mag., while small stars in like manner were dignified with 10 mag. attendants. ζ presented an especially singular appearance, having a fresh *comes* of about 7 mag., nearly opposite the ordinary one, but at half the distance. These secondary images, which were almost as neatly defined as real discs, were formed vertically above the true star, about 1″·25 or 1″·50 distant from it, upon the first diffraction ring, the light of which, on that side, seemed to be intensified into a bright spot. The appearance was unaffected alike by turning round the object-glass or the eye-piece, or by a change of magnifiers, and evidently resided in the atmosphere. Some 3-mag. stars at a similar altitude in

the S.W. showed no traces of this illusion. *Procyon* in the E. was affected in rather a different way, the light spreading along a broader segment of the ring, and oscillating to and fro. This double refraction was noticed from 8h. to 8h. 30m. p.m., the air being quite still and very favourable for observation, excepting a slight flare in a vertical direction, which latterly became horizontal, pulling out the rays on each side of the discs, and giving them (if so incongruous a metaphor may be permitted) a kind of *grinning* appearance. This passed away in turn, and though there were traces of irregularity in Orion as late as 9h., very beautiful definition succeeded. The circumstances were singularly unlike those of the previously recorded *mirage,* that having occurred on July 27; this in so cold an air that the thermometer marked 19° at 8h. 30m., and 15°·5 at 10h. 30m. The complete calm, however, rendered it very bearable, and the quality of the definition may be estimated from the fact that I never saw the trapezium in the Great Nebula of Orion so finely, and for the first time (excepting a single glimpse one beautiful night) the 6th star came out occasionally as a distinct, though excessively minute point. One eye-piece, however, alone out of three was capable of showing it. The 5th star was a steady object. The grandest astronomical discovery of the age has surely been that of the gaseous constitution of this astonishing nebula. On sweeping upon a subsequent occasion (Jan. 28th), with a power of about 30, over the whole sword of Orion, while wondering at the magnificence of the spectacle, I could not but be struck with the similarity of aspect of all the adjacent nebulosities—that round 42 and 45 to the N., and that encompassing ι to the S., as well as the great nebula between them. Secchi sees them all connected, as parts of one extended mass, whose outlying portions are still more widely spread; and in all probability the whole of this luminous cloud, traceable, according to the Roman astronomer, through more than 5° in a vertical, and 4° in a horizontal direction, may be fairly presumed to be of the same extraordinary composition. The idea of incandescent gas, lying possibly in advance of, rather than beyond, the stars with which it happens to be optically connected, is certainly less magnificent than that of a complication of stellar galaxies of incomprehensible remoteness; but what it has lost in sublimity it may be almost said to have gained in mystery.

DOUBLE STARS.

A little ranging about among the glories of *Orion* has brought forward some pairs which, though small, will repay the search. The first is

127. 84 P.V. This is very near ψ^1 *Orionis,* which is

pointed at by the three gems in the Giant's belt, at a distance equal to their full extent, but lying somewhat *n* of the line. ψ^1 itself is worth looking at for the beautiful low-power field with its open pairs in which it is found. Our object, however, lies rather further, *f*, a little *n*. It is Σ 708. 2″·607. 323°·13. 8·2 and 9·8 (of his scale, equal to about 9 and 10½ Sm.). 1831·81. It is pretty, though minute.

Reverting to ψ^1, we shall perceive, in the finder, about ¾ of a degree *sp* from it, three dim objects in a slightly curved line pointing *s*, a little *p*, the brightest at the *s* end, the faintest in the middle, but nearer *s*. Of these the *n* is

128. 67 P.V., a wide and very unequal, but pleasing pair, orange and blue. The *s* is

129. Σ 700. 4″·523. 5°·27. 8 and 8·2 (= full 9 Sm.). White. 1831·48. Mädler and Secchi's measures combine to show its fixity. Secchi made them equal, 1857·104. I thought them a little unequal, 1865·052.

Two or three degrees to the S.E., nearly *n* of ε, the central gem of the belt, but a little *f*, in a situation forming a tolerably isosceles triangle with ε and δ, the uppermost gem, a little sweeping will pick up a group of small stars, whose longest axis lies nearly parallel to the equator, from which indeed it is very little removed. This pretty configuration, which is all in the field of a moderate power, bears a slight resemblance to the constellation *Sagitta*. The stars are all white, and not very unequal in size. The two last form a wide pair, our

130. Σ 758. 11″·062. 297°·72. 8·5 and 9 (about 9 and 9½ Sm.). These, however, are much less beautiful than the central object of the group, at 51″ distance, which is

131. Σ 757. 1″·683. 239°·83. 8 and 8·2 (perhaps 8½ and 9 Sm.). Secchi's observations in 1859 were only sufficient to show that there has been no considerable motion in the group during 28 years. Its insulated aspect would seem, however, to bespeak comparative juxtaposition in space.

Our list of Double Stars has contained so preponderating an amount of easy objects that it would be only fair towards such of our readers as possess instruments of considerable power to introduce an occasional test of a higher class. Such an one we are about to insert.

132. η *Orionis*. This beautiful pair, which does not appear in the Bedford Catalogue, was discovered by Dawes, Jan. 15, 1848, who gave its approximate distance and position 1″ and 87°, with mags. 4 and 5. Mr. Knott has favoured me with the following recent measures:—0″·947. 88°·83. (1863·12). It is a serious objection to many of the more difficult pairs as tests, that their orbital motion is continually altering their distance, of which η *Coronæ Borealis* and 36 *Andromedæ*, both now so

much easier than formerly, are remarkable instances; others of them again are not easily found without circles. The fixity and conspicuousness of the present object would render it a far superior criterion, were it not unfortunately situated so far S. that, like the comites of *Antares* and *Sirius*, it becomes rather an atmospheric than an instrumental test. On really steady nights, however, it affords an excellent trial. I have often seen it divided, and occasionally with a good black separation, with 461, and even 212 will sometimes split it. The smaller component has a ruddy hue. It is readily made out as a moderately bright star lying *sp* from δ, the uppermost of the three in the belt, about as far off as the belt is long.

PLANETARY NEBULA.

In the INTELLECTUAL OBSERVER for March, 1864, p. 139, mention is made of my having missed an extremely faint planetary nebula among the northern stars of the fine cluster 46 M (*Argûs*). A remark by Mr. Knott (to whose kind assistance the present paper owes much of its details) induced me to examine it more carefully, when I found it in a low-power field (65) with so little difficulty that I can only suppose that my eye, which seems to fail me in the search for minute objects near much brighter ones, had previously been distracted by the general sparkling of the more brilliant assemblage. Till once seen, however, it could hardly be called obvious with 5½ inches of aperture. I saw it as a feeble and very ill-defined luminous disc, with a star about 10 mag. on its *sf* border, and some sparklings in it as of 13 or 14 mag. stars. H., who, in 1833, calls it "exactly round, of a faint equable light," says it has a very minute star a little N. of its centre, and is not bright in the middle, nor fading away, but a little velvety at the edges. Lassell, who examined it at Malta in 1853 with his noble 24-inch speculum, and speaks of it as "an astonishing and interesting object," says it has a star or stellar nucleus nearly, but not quite, in the centre, with another fainter star rather nearer the centre than the circumference; and that the nebula seems to retreat from the larger star, leaving it on a much darker ground than the external part of the nebula: two or three points or bright spots in the nebula also occasionally catch the eye. It appears rather singular that the star towards the *sf* edge, so readily seen by Mr. Knott and myself, should find no place in the descriptions of either of our two great observers. Possibly it may be variable. Sm. says most appropriately that the impression given by this nebulosity is "that of awful vastness and bewildering distance"; but this is on the supposition of its starry nature. If gaseous, it may

lie even between our eye and the cluster; but its light may prove insufficient to admit of spectrum analysis. Its synonyms are 39 ♅ IV; 464 H (1833); 1565 General Catalogue.

OCCULTATIONS.

March 3rd. δ^3 Tauri, 5 mag., 10h. 16m. to 11h. 2m.—8th. A^2 Cancri, 6 mag., 7h. 16m. to 8h. 36m.

PROGRESS OF INVENTION.

Railway over Mont Cenis.—Notwithstanding all the aids afforded by modern science, the tunnel under Mont Cenis cannot be finished for several years. It has therefore been decided, in the meantime, to carry a line *over* the Alps, following, almost throughout, the route afforded by the pass of Mont Cenis. France and Italy will thus enjoy the benefits of railway communication within a very short period of time. To effect this, however, it will be necessary to overcome engineering difficulties, which, not long since, would have been deemed insurmountable. The line naturally divides itself into two portions—that on the French, and that on the Italian side; and it is not the least interesting feature of the undertaking that the engineers of these two nations have resolved on attaining the very same object by totally different means. On the French side, locomotives will be used, on the Italian, traction by ropes. On the French side steam, on the Italian, water power. With such gradients as must necessarily be found on this line, a sufficient adhesion between the driving-wheels and rails could not possibly be attained by ordinary means: a very ingenious method of producing any required amount of friction has, therefore, been adopted. A species of rail is to be placed between the ordinary rails: against the upper and lower sides of this, rollers, driven by the engines of the locomotive will act. The central rail being caught between these rollers, any amount of compressing force can be obtained, so as to render it impossible for the engines to work without progressive motion being produced, and equally impossible for the train to descend the inclined plane of its own accord, or too rapidly when descent is intended. On the Italian side, the system of traction is altogether different from that ordinarily used when ropes are employed, and it avoids some of the most serious objections to the use of ropes. A strong cable is placed in the middle of the line, and also an endless wire rope, which is very light, and is kept constantly in motion by power obtained from falling water. Within a waggon, constructed for the purpose, is placed a drum which forms the last element of a system of wheels and pinions. One turn of the cable is passed round this drum. The first element of the system of wheels and pinions is capable of being brought into connection with

the constantly moving endless wire rope. If this element is connected with the ascending portion of the wire rope the train ascends: if with the descending portion, it descends, and exactly at the proper speed: if it is connected with neither, the train remains stationary, being prevented from descending by that part of the cable which happens at the time to be around the drum. The velocity with which the wire rope moves is very great; but this velocity is changed into power, by the system of wheels and pinions in the traction waggon; the required fulcrum being supplied by the strong cable.

Novel use of Water Pressure.—Few persons not familiar with mechanics have any idea of the enormous loss of power which occurs when the masses to be moved are large, and the velocity is high. Friction is greatly diminished by lubricating substances, and still more by friction rollers, but, with ponderous machinery the application of the latter is rarely possible. A contrivance calculated to supply the place of friction rollers, and even to surpass them in efficiency, is coming into use in France. Water, to which a sufficient pressure has been imparted by forcing air into the tank in which it is contained, is made to flow out between the axle and the bearings which sustain it—so as actually to keep the axle lifted out of contact with the surfaces on which it rests. A water pressure of ten atmospheres was found sufficient to effect this with a fly-wheel weighing 35,000 kilogrammes. When this wheel is first started, the bearings are merely lubricated in the ordinary way: but the water is turned on immediately, which causes a very great increase in the velocity of rotation, without any change in the amount of moving power. In experiments which were made to ascertain the efficiency of the principle, it was found that, with merely well greased bearings, the co-efficient of friction was ten per cent., but that, when the water pressure was used, it fell to 0·001, and was never more than 0·003. This arrangement is well suited to the bearing of screw propellers, etc., where heavy weights are to be moved at high velocities; and to test its efficiency, the French Government has ordered it to be applied to the propeller of the screw steam-tug, "Elorn."

Use of Non-insulated Wire for Electro-Magnetism.—A communication made by M. de Moncel to the French Academy of Sciences, at its sitting on the 6th of January, has excited considerable interest, and caused a large amount of controversy. He announced that, in verifying some experiments of M. Carlier, with regard to the use of non-insulated wire, which was described in our last number, he not only ascertained the correctness of M. Carlier's assertions, but arrived at results that filled him with astonishment. He found that not only are helices made of non-insulated wire capable of producing all the results attainable with those in which insulated wire is employed, but that the power is often doubled. He ascertained that, to effect this, it is only necessary to separate the different layers of coils with paper, and, if the bobbin is of metal, to insulate it. He considered the increased power, obtained in this way, as due to the derivative currents which pass across the coils at the points of contact,

and which, though they weaken the current travelling along the wire, augment the total effect by producing an extra excitement of the battery, so that far more is gained in one way than is lost in the other. He ascertained, however, from subsequent experiments, that advantage is on the side of non-insulated wire only when the battery is calculated to produce, or is arranged for, *quantity*—which greatly limits the advantages that such an arrangement may possess. Among these is the partial or total absence of an extra current. Still more recent researches have led him to discover that a large amount of the supposed superiority of the non-insulated wire was due to an accidental superiority as to conducting power, which it happened to possess over the insulated wire that was used in the comparative experiments. Making, however, every allowance for this circumstance, it is still certain that non-insulated wire is best when a quantity-battery is employed. Not only is it cheaper, but it allows a greater number of coils to be put within the same space, which of itself augments the electro-magnetic effect. The use of non-insulated wire for electro-magnetic purposes is not new.

A NEW KIND OF ELECTRIFYING MACHINE.—The electro-magnetic coil has, in a great measure, superseded the electrifying machine: the latter, however, will never cease to be an object of interest; and, it is probable, will always be preferred for some purposes. The expense and difficulty of managing large plates and cylinders of glass have hitherto been obstacles to the use of large electrifying machines. These obstacles appear now removed—glass being rendered unnecessary by the discovery of a far more convenient and effective material. M. Edmond Bequerel exhibited to the Academy of Sciences on a recent occasion an electrifying machine, the plate of which was made of indurated red sulphur, the invention of a civil engineer. It was eighty centimetres in diameter, and afforded a spark fourteen centimetres in length. No amalgamated cushions were required with it, the skin of a cat being quite sufficient to produce every desired effect. Sulphur undergoes extraordinary changes by successive fusions; becoming extremely hard and tenacious. After the third fusion it no longer acts on metals, or possesses its characteristic odour. The plate used by M. Bequerel was formed by fusing the sulphur three times in a cast-iron vessel, at a temperature between 250° and 300° Cent., and allowing it, after each fusion, to cool thoroughly. After the first and second fusions it was crushed to a coarse powder; and, after the third, it was poured into a plaster mould. Plates four metres in diameter may easily be made in this way; they cost extremely little; and, besides being more efficient, are far less hygrometric than glass.

NEW METHOD OF COPYING CRYSTALS.—To produce very beautiful copies of crystals, M. Kuhlmann coats a thin plate of copper with sulphate of magnesia or of zinc, thickened with gum; then lays the copper-plate against another, with the coated surface between, and passes both plates between powerful rollers. The second plate may be employed at once in printing, or it may be reproduced by the electrotype. Instead of a copper-plate he sometimes employs glass, taking impressions of the crystals in gutta-percha, and reproducing

the designs, as before, by the electrotype. As no two crystallizations are exactly alike, and they cannot possibly be copied by the engraver, nor by the photographer, if coloured ink is used, it is considered that printing them from the electro-plates on bank-notes would afford a great additional protection against forgery.

Improved Thermo-Electric Pile.—Up to this time, bismuth and an alloy of antimony have been considered the very best elements for thermo-electric piles. Professor R. Bunsen has, however, recently found that pyrolusite may be employed with far better effect than bismuth, and copper pyrites, with far better than pyrolusite. The pyrites must be used in the natural state, since fusion reduces its power below that of bismuth; but it is easy to form it into a plate of the required size. It was found that a pair consisting of a plate of copper pyrites seventy milimetres long, forty broad, and seven thick, with two copper pins, platinum plated, inserted into it at a distance of thirty-five milimetres from each other, the upper pin having a projection which was heated by a non-luminous lamp flame, while the lower edge of the plate was placed in water, afforded a ten times greater effect than a pair consisting of antimony and bismuth; and a combination consisting of ten such pairs produced all the effects of a Daniel battery, having a copper surface of fourteen square centimetres. During these experiments, the pyrites was heated above the melting point of tin without undergoing any change. Copper pyrites and platinum affords also an excellent pile.

Metallic Coating, so as to Produce a White Surface.—This is effected in a very simple way, by M. Weil. He makes an alkaline solution of the metal which he intends to deposit, and adds to it tartaric acid, glycerine, or some other organic matter. Iron, steel, etc., may with such a fluid be coated with copper, zinc, nickel, etc., and beautiful bright surfaces be obtained. It is usually sufficient to place the object to be coated in the alkaline solution; but, if required, a weak galvanic current may be generated, by bringing it into contact with a piece of zinc.

Lucifer Matches.—There are many reasons which make it highly desirable that phosphorus should be rendered unnecessary in the manufacture of matches. Phosphorus produces one of the most terrible diseases of the jaw in those who manufacture it. No doubt this would not occur were amorphous phosphorus employed; but the latter is dearer, and how few are there so philanthropic as to pay more than is absolutely necessary for anything they require. Also phosphorus, especially the ordinary kind, is highly combustible. How many buildings have been burned, how many lives lost through the careless treatment of lucifer matches! Lastly, phosphorus is one of the essential elements of plants and animals, though it is found in comparatively but small quantities. It is highly mischievous, therefore, to place vast quantities of it in circumstances in which it is scarcely possible for it again to return to the soil, where it is so much needed. Two German chemists seem to have made good lucifer matches, containing no phosphorus. One of them, Dr. H. Poltzer, uses for the match heads a mixture of

chlorate of potash, and, as he believes, a compound of hyposulphurous acid with soda, ammonia, oxide, and suboxide of copper. He obtains this compound by dividing a solution of copper into two equal parts, supersaturating one with ammonia, and the other with hyposulphite of soda; then mixing the two solutions, and stirring briskly. One part of the violet coloured powder which precipitates is mixed with two parts of the chlorate of potash, a little powdered glass being added. This composition detonates by percussion, and ignites when rubbed in a mortar. It is not soluble in water, nor is it hydroscopic; but even when made with moist chlorate of potash and solution of gum its cohesion is so imperfect, that it often crumbles off the matches when they are rubbed. It is also liable to the objection of requiring no particular kind of surface for ignition, which involves the danger of causing conflagrations. Dr. Hierpe uses for the match heads four to six parts chlorate of potash, two parts bichromate of potash, two parts ferric oxide, and three parts strong glue. The ferric oxide may be replaced by oxide of lead, or of manganese. Matches made with this composition will ignite only on a surface coated with a mixture containing twenty parts sulphide of antimony, two to four parts bichromate of potash, four to six parts oxide of iron, lead, or manganese, two parts glass powder, and two to three parts strong glue or gum.

Gas Engines.—It is one of the advantages of modern progress that many operations formerly performed by the painful efforts of man and animals, are now effected with much greater ease and economy by means of power obtained from other sources. A striking illustration of this is found in the use of portable steam-engines in public works. Perhaps a still more striking is the utilization of the enormous water power available in Paris for the lifting of heavy weights to great heights, and in the employment of Lenoir's gas engine for a similar purpose. It is evident that for intermittent efforts the steam-engine is far from economical, on account of the necessity of keeping up the steam during the intervals of inaction. This objection does not hold with the gas engine. It consumes nothing when it is not actually at work, it is, besides, very portable, and the gas, as also the water for refrigeration, it requires may be had almost anywhere. It is not surprising, therefore, that it is coming into use in France in building operations, any defects it may possess being more than counterbalanced by the advantages it offers.

The Electric Light Adapted to Use in Mines.—Notwithstanding the excellence of Davy's lamp, especially in its improved forms, the most lamentable accidents are of constant recurrence in mines; sometimes, no doubt, they are due to imperfection in the lamp, but most usually to imprudence in the miners. The use of electricity, as a means of illumination, would remove all danger of this kind; but hitherto its light, though very intense, was useless for ordinary purposes on account of the impossibility of rendering it sufficiently diffused; and, besides, its arrangements were complicated, on account of charcoal points being necessary. These objections seem

to have been overcome by a lamp maker of Paris. Instead of charcoal points he employs an apparatus of glass, within which the air is greatly rarified, so as to allow a passage to the electricity, and afford a mild light, something like that of an aurora borealis, but quite sufficient for the miner. As this lamp produces no heat whatever, it is impossible for it in any circumstances to ignite an explosive mixture of gases. The galvanic battery it requires is enclosed in a small box, which is carried on the back of the miner, or is placed in any convenient situation near him.

Mr. Stewart Harrison's Self-Acting Preserver Valve, for the Preservation of Life and Property from Fire.—This valve is part of a system designed by the inventor to prevent the occurrence of fires, in the official sense of that word, by extinguishing them at their commencement. He proposes that in warehouses, at the docks, in public buildings, libraries, etc., wrought-iron pipes connected either with a tank on the top of the building, or with the fire mains in the street, shall be put up on the ceiling of each floor, so as to divide the surface to be protected into spaces, greater or less, according to the combustibility of the goods. To these pipes, the preserver valve is to be attached. The valve, which is globular in form and perforated with numerous holes, is kept closed by a screw passing through a stirrup of brass, whose ends rest on two small pins of fusible metal, which melts at 212 degrees Fahr. Upon a fire breaking out, the heat ascending to the ceiling, and melting one of the pins belonging to the nearest valve, the water is poured down on the precise spot at which the fire is commencing. Should the heat be sufficient, it will melt several of the pins immediately surrounding the central point, and the water falling on the goods below will prevent the spread of the fire to them. In this way, it is believed by the inventor that it would be impossible, with a proper supply of water, for the damage under any circumstances to be very great. For libraries, dwellings, etc., the valve can be concealed beneath ornaments on the ceiling, without any disfigurement to the rooms in which it is fixed. For ships and steam-vessels, where a large tank of water is not possible, the pipes run along the beams, and are connected with a cistern on the highest part of the deck. When the valve opens, the altered level of the water in the cistern causes a float to sound an alarum ; on which the ship's fire-engines are connected with the system of pipes, and the water from them is directed exactly on the seat of the fire. The water is not, therefore, as at present, blindly thrown wherever the smoke may appear (however falsely) to indicate the part on fire, injuring the cargo as much as the fire itself. Mr. Stewart Harrison has also designed an alarum, which sounds whenever the water flows through any of the valves, thus giving timely notice to the watchman, porter, or passer-by, that the fire is being put out, and enabling them, on its being extinguished, to prevent further damage by turning the water off from that set of pipes. The valve and alarum, we believe, can both be seen in action at the inventor's, No. 133, Upper Thames Street, E.C.

Miscellaneous.—The *lime light* has been applied to the produc-

tion of enlarged images of opaque objects, such as photographs, for the use of portrait painters, etc. It is reflected from a large concave mirror through a nine-inch condensing lens ; and passing thence to the object, which is placed at an angle of 45°, it is reflected to a double acromatic object-glass, which refracts it so as to form a picture on the screen intended to receive it.——*Aluminium bronze*, consisting of ninety parts copper and ten aluminium, is used with very great advantage as a casing for bearings which, when ordinary materials are used, are liable to become heated, on account of the high velocities of the moving parts. It was found to answer admirably for a mandril, which made 7000 revolutions in a minute, and with which, every other bearing tried, had proved a failure.——*Electro magnetism* has been applied by Sir Charles Fox to the overcoming of one of the greatest difficulties connected with railways, namely, the want of sufficient adhesion between the driving-wheels and the rails. For this purpose, deflected belts of insulated wire are placed round the lower portions of the driving-wheels of the locomotive, which, when these belts are connected with a galvanic battery, become powerful electro-magnets that attract, and are attracted by, the rails. As the wheels revolve within the belts, their lower portions, for the time being, are always magnetic. The belts are supported by slings, and steadied by stays, and are capable of being connected together, etc.——It is supposed that the sudden and spontaneous extinction of burning *magnesium wire* arises from the presence of particles of oxide. Magnesium possesses no ductility ; and hence, to form it into wire, it is forced in a fluid state through holes in a steel die. This causes portions to be oxidized, as the metal is highly oxidizable in the fluid state, and the particles of oxide are incorporated with the wire. All inconvenience from this oxide is prevented by adding to the magnesium lamp a spirit lamp, through the flame of which the magnesium wire is transmitted at a proper speed, by means of suitable mechanism.——It has been proposed to propel omnibuses, etc., through Paris by means of a motive power, which is to be derived from *gaseous ammonia*. It has been calculated that if twenty kilogrammes of liquefied ammonia are vaporized, and the vapours are received in sixty kilogrammes of water, a power equivalent to that of two horses for one hour, and sufficient to propel an omnibus through Paris, will be obtained. This use of ammonia is believed, by the projectors, to be feasible, because, first, gaseous ammonia may easily be liquefied ; secondly, its vapour affords at ordinary temperatures a pressure that is utilizable, and it may be superheated without recourse being had to a high temperature ; and, lastly, the latent heat may be recovered from the utilized vapour, and communicated to the vapour which is about to be produced, by a mere solution of the gas in water. It is proposed to manufacture liquid ammonia in large quantities in a central establishment, from which it will be distributed, as required, to the various omnibuses, etc. ; and to bring to the same establishment the water in which the ammoniacal vapour will have been condensed, that the ammonia may be recovered from it.

LITERARY NOTICES.

Harmonious Maxims of Science and Religion. By the Rev. William Baker, M.A., Vicar of Crambe, near York (Longmans).—The author of this work contends that the reconciliation of science with theology must be effected by tracing out in both departments a series of truths, which only became cognizable through accurate study, and which often contradict those interpretations of natural or revealed phenomena that are accepted by the unlearned. We can only mention the scope of this book, without offering any opinion on its merits or defects.

Philosophy of Religion. By Hugh Dogherty, M.D. (Trübner and Co.)—This is a short pamphlet of controversial divinity, a subject with which we do not meddle. Those parts which touch general philosophy appear to us to want precision and distinctness. Dr. Dogherty is too fond of long-tailed words and learned-looking expressions. We certainly do not feel disposed to attack his "epicosmology" with its "sacred numbers in individual organisms; discrete organisms in the indivisible unity of human nature," its "one primary and three secondary classes in its realm in epicosmic nature;" or its "three degrees—individual, realmic, and epicosmic." A wise man will always distrust thoughts that cannot be expressed in simpler terms.

Inventive Drawing: A New Practical Development of Elementary Design. By Edward Ball. (Hardwicke.)—This is an admirable work. Mr. Ball's notion of teaching drawing is both practical and philosophical. All objects in nature, and beautiful productions in art, may be analysed into simple elements. The most elementary forms will be combinations of rectilineal angles, or angles formed by straight lines. Mr. Ball shows how, from the simple meeting of two straight lines, the pupil may proceed to pleasing pictures formed by combinations of straight lines; and he likewise illustrates the approximate mode in which they can be made to represent animal forms grotesquely caricatured. Part II. relates to the combinations of triangles, in which the progress of rectilineal design is carried further than in Part I., and we arrive at patterns of considerable elegance, entirely formed of a multiplicity of triangles of various sizes, and in which the effect of shading is produced by making nests of triangles, one inside the other, repeated five or six times. In Part III. four-sided figures assist the triangles in building up fresh devices, and in Part IV. simple curvilinear figures are introduced, and excellently applied. Part V. is devoted to geometric figures, bounded by right lines; and the subject is continued in Part VI., in which curves and right lines are combined. Part VII. is devoted to "designs from nature, illustrating the use of the elementary and compound forms in diapers;" and Part VIII. shows how simple, but effective patterns for windows may be composed. The merit of this work consists in the execution as well as in the idea. It will lead the student on pleasantly and

quickly, first, to see in the objects around him the artistic elements of which they are composed, and, secondly, to perceive how these may be combined so as to produce an endless variety of effects. The book offers suggestions that will be valuable to practised adults, but its well-arranged steps and excellent illustrations will soon conduct any tolerably clever child to a substantial, though rudimentary knowledge of drawing and of decorative art. The book will be a favourite in every family in which it is introduced, and it will be found that most children begin to attend to form at a much earlier age than is commonly supposed. We remember a clergyman at Huntingdon who managed some schools for his poor parishioners with great skill, and he found that little creatures, four or five years old, took great delight in tracing the outlines of forest leaves on a scrap of paper. In many cases this was the foundation of considerable proficiency in subsequent life.

Two Months in a London Hospital; its Inner Life and Scenes: A Personal Narrative. By Arnold J. Cooley, Author of "Cyclopædia of Receipts, Processes, Dates, and Collateral Information," "Dictionary of the English Language," "Latin Grammar," etc., etc. (Groombridge and Sons.)—A severe and dangerous accident unfortunately made Mr. Cooley the inmate of a London hospital, and he improved the melancholy occasion by watching all that occurred within his sphere of observation, his own sensations included, and compounding his experience into a very readable book. The details of hospital life are well described, and many pathetic and startling incidents graphically pourtrayed. Mr. Cooley suffered with an attack of erysipelas, which made him delirious, and he has recorded the strange fancies that arose in his disordered mind, and the various scenes in which he imagined himself to be an actor or spectator. These chapters will interest many readers, and they are not without scientific psychological value. He remarks, with reference to this part of his experience, that "the quiet delirium of erysipelas—that variety which has chiefly to do with my narrative—is more closely related to dreaming than the others. Indeed, whether occurring by night or by day, it clearly resembles a continuous day-dream of a varied and very vivid character, occurring with the senses, or some of them, more awake than in what is popularly called 'day-dreaming,' by which the sequence of ideas or illusions, though irregular, are usually more connected, persistent, and continuous than in ordinary dreams. In general, as in dreaming, the illusions and irregular trains of thought primarily depend on the suggestions of immediate influences. Among these, sounds heard and misunderstood by the patient are the most prolific. His pains and sensations also act in the same way. The subject, the thoughts floating through his mind as he passes into a delirious state, likewise frequently furnish the groundwork on which his subsequent wanderings are raised. Then imagination begins her work, and memory supplies her stores to continue and diversify the vision or illusion. And, lastly, the usual habits or bias of the mind in health give a tone to the whole, and leave the thoughts rambling on a train of favourite subjects, until the patient is

aroused, or until he sinks into a state of actual sleep or stupor from exhaustion."

Notes upon the Errors of Geology: Illustrated by Reference to Facts observed in Ireland. By John Kelly, Vice-President of the Royal Geological Society of Ireland. (Longmans.)—Mr. Kelly is acquainted with a considerable number of geological facts, and he puts them to a very curious and singular use. He thinks men like Lyell, Murchison, Phillips, and Ramsay all wrong. They can only account for the appearances they observe upon the supposition that the causes producing them were in action during very long periods, while Mr. Kelly requires all sedimentary rocks to be made in a hurry. He supposes that a few thousand years ago there was a turmoil in the interior of the earth, and "its hard nucleus of granite was split up into large blocks by volcanic agitation." "Suppose," he says, "one of these blocks heaved up by the expansive power of steam, and, on the escape of the steam, let down again by its own gravity. In the fissures or joints about the block, after having been put in motion, there would have been a considerable amount of ground granite made by the sliding or friction of the moving block." Notwithstanding that this process is supposed to have taken place at the bottom of the sea, the "granite would be," in Mr. Kelly's hypothetical arrangements, "red-hot, or nearly so." Having obtained a large quantity of powdered granite, nothing is easier than to make it into strata, sorted out according to the size of the particles. It only requires "another volcanic heave and a puff from below" to scatter all the materials about in the water, and allow them to subside into any quantity of sedimentary rock that might be required. The operation commences with the formation of great cracks in the sea bottom. "Call every such fissure a Grinding Machine. In this way give it steam power to lift the block, gravitation to cause it to slide down, friction to grind off projections in the act of sliding, and make sandy depressions to receive this sand; and steam again to blow out the ground stuff, a vacuum left in its place, cold water to rush into the vacuum, hot granite to convert that into steam again, for a new effort." Ten or twenty thousand of such grinding machines all going at once in a hundred square miles of ocean bottom, would, according to Mr. Kelly's computation, make a bed over the whole area twenty miles thick in a century, or, working at half speed, they would turn out "any of our geological systems" in that time. We ought to add that Mr. Kelly knows of actions of this sort in Ireland, we presume in some parts, verifying the old joke, that the laws of nature refuse to operate in that interesting country.

ARCHÆOLOGIA.

The season is very far from favourable to any new archæological discoveries, and we are obliged to fall back upon some of the later explorations of the past autumn, which are still occupying the attention of antiquaries. Among these may be specified the less recent discovery of the foundations and floors of BUILDINGS IN CHESTER, the *Deva* of the Romans, under whom it was the station of the twentieth legion. Two lectures on local antiquities have recently been delivered at Chester by Dr. Brushfield, a prominent feature in the second of which was a searching inquiry into the grounds upon which Mr. Tite founded his opinion, that a building laid open during the last year in the heart of the town was a Roman temple. Mr. Tite had published his reasons in a paper read before the Society of Antiquaries, and Mr. Scarth, in his "Roman Bath," has drawn attention to its analogy to a temple discovered years ago in that city. Dr. Brushfield disputes the correctness both of Mr. Tite's conclusions and of his facts, and the close attention he and his coadjutors gave daily to the remains during the discovery adds weight to his views. The lectures, with illustrations, are about to be published by the Chester Archæological Society.

We have already described the EXCAVATIONS AT BRADWELL juxta Mare, which appear to have brought to light at last the remains of the lost Roman military station of Othona, the Ythancester of Bede. These researches are, we believe, still continued as the weather permits. Some antiquaries had already conjectured that it stood somewhere near this locality; but what caused others to pause before deciding was not only the fact that no vestiges were to be seen here, but the conflicting fact, as it seemed, that at Felixstowe, on the Suffolk coast, the sea had overthrown a Roman castrum, parts of the walls of which are still to be seen at low water. At one place, therefore, remains existed without historical evidence or any affinity in names; at the other, the site on the river Pant is pointed out by Bede, but no remains were to be seen. The site at Bradwell had, as we have stated in our former notice, a ruined church named St. Peter's-on-the-Wall, apparently of late Norman work, and constructed in part of Roman materials. It was hardly supposed that this church was so termed from standing upon one of the walls of a Roman station, yet this turns out to have been the case. Further investigation will no doubt throw more light on this interesting question.

In these days of universal explorations, it is something noteworthy to bring to light A ROMAN WALLED STATION; but it is probable that, even in our own country, remains of this kind are yet to be found for the trouble of excavating; and this is the case, to a more remarkable degree, in some parts of France. It is only a few years ago, a French antiquary, M. Boilleau, discovered at Larçay, near Tours, a fine and very well-preserved Roman fortress, with its massive walls almost entire. It stands a short distance out of the

road, and no one ever thought of looking for it. Mr. Roach Smith has given some account of this discovery in his "Collectanea," vol. iii. p. 218; and in the same volume, p. 103, he has given a longer and still more interesting account of the extensive remains, at the village of Jublains, in the department of Mayenne, of the ancient chief town of the Diablintes, which, until recently, had been almost as little known. The whole district of Mayenne and Jublains is, indeed, almost unknown ground; and Mr. Roach Smith informs us that, on his visit to Jublains, he found *in the woods* remains of large buildings, the walls of which had been cased with thin slabs of polished marbles of various kinds, and an amphitheatre, not excavated.

We have just received information of an interesting discovery lately made in this last-mentioned district. At a particular part of the river, where there seems to have been a bridge or ford, in the route from Jublains to Avranches, portions of a milestone have been found, and upwards of three thousand coins, many of which are of the flower of the die, having been preserved from the action of the air by the water, precisely like those found in the Thames at London Bridge. Of these coins, three are consular, many of Augustus, seven hundred of Claudius, many of Nero, more than five hundred of Tiberius, others of Caligula, Germanicus, Hadrian, Nerva, Trajan, Vespasian, Titus, and Domitian; some rare colonial coins; five or six of the two Faustinæ. Of the lower empire there appears to be only a few, three of which are of Gallienus, Postumus, and Tetricus. Among other remains found with them are a bronze axe, or, as we understand it, one of those implements our antiquaries are accustomed to call celts. The miliary column alluded to has an inscription, of which only the following letters remain:—

. . .
NIO.V
INVIC
AUG.P.
).IIII

The last line gives, no doubt, the distance from Jublains, the capital town of the Diablintes (about four miles).

We can hardly allude to the progress of archæology in the month of February, without a passing word on the loss of one of the great patrons of this science, who has just been gathered to his fathers. The late Duke of Northumberland was a zealous and enlightened encourager of antiquarian research, especially in that part of England in which his own ancestral estates chiefly lay. He had patronised largely the labours of Dr. Bruce on the antiquities and history of that great monument of the Romans in Britain, the wall of Hadrian; and he had expended large sums of money in an efficient survey not only of the wall, but of the other Roman remains in Northumberland, the result of which was an important work, printed for private distribution, under the title, "The Roman Wall, and Illustrations of the Principal Vestiges of Roman Occupation in the North of England; consisting of Plans of the Military Works, the Stations, Camps, Ancient Ways, etc., from Original

Surveys made by direction of his Grace the Duke of Northumberland, K.G.," by Henry Maclaughlan, folio, 1857. These antiquarian researches were, we believe, continued till near the time of his demise.

T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

NATURAL HISTORY SOCIETY OF DUBLIN.—*Jan.* 6.

On Fissiparous Reproduction Observed in Anthea Cereus.—Dr. E. H. Bennett read a most interesting account of an instance of fissiparous generation which he had been enabled to observe accurately. One morning last July he brought from Seapoint three specimens of *Anthea cereus* (the ash-coloured variety), and put them into a large aquarium. They were uninjured, and at once attached themselves to the stonework of the aquarium, expanding their tentacles to the full. He had on previous occasions failed in getting this species to do well in the vessel, from some fault in its management, and consequently watched these with some interest. During the evening of the day on which they were put into the vessel he was surprised to see one of them moving about in a most unusual manner. The species is always rather restless as compared with others, but this individual seemed to be suffering from some extreme excitement, being constantly in rapid movement along the stone-work, and waving its long ash-coloured tentacles in the wildest manner. Late at night the Anthea was on the highest point of the stonework, in the centre of the vessel; in the morning it was attached high up the front glass of the vessel, and was still in the same state of excitement. Its position on the front of the vessel afforded the best possible opportunity for the examination of its structure and movements. He made a most careful examination of it, and assured himself that it was perfectly free from any injury. On his return home, at about three p.m., he at once examined it and found that there was in the centre of the base a small, irregular opening; the base itself was no longer circular, but had extended itself in the vertical direction to the utmost, and formed a long, narrow oblong. So great was its extension lengthwise, that the column of the animal was almost flat on the glass. The opposite ends of the base seemed to be working to the utmost to increase the distance between them, and the tentacles waved about more vigorously than in the morning. It occurred to him that this excitement and muscular exertion in the base was owing to the fact that the animal was attempting to divide spontaneously. He determined to watch the process, and sat down in front of the vessel. In a few moments the opening in the base became wider, more irregular, and was evidently increasing

from the violence of the muscular efforts. Presently the opening in the base extended to the margin, and up the right side of the column, exposing to view the internal structure—the septa and so-called craspeda. At 4·20, twenty minutes after the rent had reached the right margin of the base, it extended to the left, and so divided the whole base into two nearly equal segments. It is a curious fact that the tentacles corresponding to the two parts now contracted separately; hitherto the contractions were convulsive, and set in suddenly at intervals and altogether, now there was a distinct pause between the convulsion of the upper and lower division, the upper always preceding the lower by a few seconds. At 5·10 the walls of the stomach could be seen strained across the fissure, and they presently gave way, the rent extending right through the column to the oral disc. This appears to suggest that the seat of the central nervous system of Actinia occupies the base, as Spix thought he had demonstrated, although this demonstration has been rejected by every authority who has followed him. On one margin of the disc the rent involved the base of one of the outer row of tentacles, and extended along it. He was much interested in watching its progress along the tentacle, as it seemed doubtful whether it would tear along its whole length, or detach one or other half from its attachment to the body. The strain seemed great on the parts, and at last the lower half tore off from its base, and, immediately closing into a perfect tube, hung as a branch from its parent trunk. The wound in this, too, seemed to close at once when the strain was taken off. Dr. Bennett mentioned this apparently trivial detail as it appeared to explain the occasional occurrence of the double or branched tentacle which has been observed in *Anthea cereus*. At 5·45, less than three hours from the commencement of the process, the division was complete, the upper half falling to the bottom of the vessel. At 6·5 the lower followed it, and the two new individuals lay together almost motionless. Next morning one attached itself to the glass, and showed its base nearly perfect; the other lay much in the same place as the evening before. Dr. Bennett was unable to continue his observations on these two animals any further; the water in the vessel became turbid, and many of its inhabitants died, including the two *Antheæ*. They were able to move about for some days, but never with activity. They seemed, however, to have quite closed up their wounds. He could not examine them anatomically, as they were so softened before removed from the vessel that dissection was impossible. The others of the same species which were put into the vessel had also tried to divide, and apparently in the same way, from base upwards. The observation proves that division was completed, and that the two halves lived as independent animals for a few days. The whole time which the division took, from the first observation of the opening in the base to the complete separation of the halves, was barely three hours. The exciting cause of the process seems to have been the condition of the water in the vessel, just verging on decomposition. The most important part of the observation is the mode of the division.

The only case recorded of a similar kind is in Gosse's *Tenby*,

where, speaking of the rarity of the occurrence of fissiparous generation in Actiniaria, he states that he had never seen it occur spontaneously himself, but quotes the following observation of a friend:—"An *Anthea cereus*, which had been in captivity thirteen days, devoured with great relish a dead shellfish. I watched the operation of seizing and swallowing, and there was nothing remarkable in the appearance of the Anthea on Monday. On Tuesday morning, going to look at my prisoner, I observed the rejected shell at the bottom of the jar, and, to my great puzzlement, instead of one Anthea there were two, of nearly equal size, but smaller than my old friend. Both appeared languid, and from the margin of one two tentacua appeared sprouting; they hung in so very flaccid a state that I could not examine the mouth yesterday, but to-day one exposes a mouth fully formed." We have little else recorded here than the fact of the division and its extreme rapidity. There can be little doubt that in this case, as in Dr. Bennett's, the division was effected by muscular action. Nearly a century ago Decquemare observed that several Actiniæ could be divided artificially in almost any way, the several parts being capable of forming independent animals. Sir J. Dalyell has recorded a mode of reproduction in one species—*Actiniœ lacerata*—accomplished, apparently, by muscular action. He describes, in this species, the outline of the base becoming sinuous, and the prominences gradually, in the course of a week or two, becoming pinched off, maintaining their connection only by a very slender lengthened filament, not in contact with the glass, but free above it. Rupture of the connecting thread at length takes place, and the independent fragment becomes developed into a perfect anemone. He says of the process:—"It is not quite obvious how the prolongation is effected, unless by contraction of the basis and recession." All authorities agree in stating that fissiparous generation occurs either in the way described by Dalyell—by separation of a part of the margin of the base, or by division from above downwards, not from below upwards, as I have described. Milne Edwards says:—"Spontaneous fissiparous generation occurs either by detachment of fragments from the inferior border of the body, which, continuing to live, become developed into perfect animals, or at other times division commences by a narrowing or strangulation (*etranglement*) of the superior extremity of the body, which, becoming more and more pronounced, causes a bifurcation, the branches of which complete themselves each on its own side, so as to constitute two distinct individuals. These may remain united by the base, and so cause an aggregation of polypes, or may be separated completely." Dalyell is the only authority who attributes the separation of the fragments, in any case, to muscular action. How the process is effected when it occurs in the more common way—from above downwards—is difficult to imagine, unless it be similar to ulceration in higher animals, or due to muscular action. Gosse evidently attributes it to a process of growth. He says:—"The greater part of the Astræacea increase by disc buds and spontaneous subdivision, the disc of the polype gradually widening by growth,

and finally separating into two portions, which become independent." Whatever be the means by which the separation is accomplished, in the greater number of cases it was evident that, as in the exceptional case recorded, the animal absolutely tore itself into halves; and further, that the division occurred in a direction from below upwards, the reverse of that which is supposed by some to be the constant mode in the class.

PHILOSOPHICAL SOCIETY OF MANCHESTER.—*Jan.* 24.

On the Physiological Effects of Carbonic Acid.—Dr. Angus Smith related the results obtained by some very valuable experiments on breathing in close chambers. Dr. Smith had an air-tight leaden chamber constructed, containing 170 cubic feet of air. On remaining in this chamber until the carbonic acid produced by his breathing, and the burning of candles amounted to 3·9 per cent. of the enclosed atmosphere, he found that his pulse fell so low that he was scarcely able to count the beats, which diminished rapidly in number. As this effect was speedily produced, and as there was no time for the accumulation in the air of any large amount of organic matter, the effect must have been chiefly due to the carbonic acid. The experiments were frequently repeated, each time with the same results, the number of beats of the pulse diminishing as the carbonic acid increased in quantity, and the breathing quickening in the same ratio. The lowest amount of carbonic acid producing these unfavourable results was found to be 0·1 per cent., an amount often greatly exceeded in private houses and public meetings, where it often rises to 0·2 or even 0·3 per cent. As a proof that the long-continued action of an atmosphere charged with an undue quantity of carbonic produces permanently injurious results, Dr. Smith quoted the cases of the Cornish miners, who are remarkable for the peculiarity of a feeble pulse. In Dr. Smith's experiments the pulse and the breathing returned to the normal state after a few minutes' exposure to fresh air, the rapid, gasping, or panting effect produced by the carbonic acid quickly passing away.

ROYAL INSTITUTION.—*Feb.* 3.

Mode of determining the Atomic Weight of an Element.—Professor Odling's discourse on some new compounds of the metal aluminium, although of especial interest to the chemist, offered a good opportunity to every one moderately conversant with science, of becoming acquainted with a most important chemical doctrine. The question which has been agitating the chemical world during the last few years is this:—"How can we tell the true atomic weight of an element?" In other words, "What is the smallest proportion of any element, taking hydrogen as the unit, which can enter into a chemical compound?" In the annexed abstract of Dr. Odling's remarks, an answer to this question, so far

as it relates to the element aluminium, is given. The subject was introduced by a few words relating to the more ordinary aspects under which this element is generally regarded.

Of all the elements, aluminium is the third in order of abundance; among the metals themselves it is the most abundant. Yet it seems not to be a necessary constituent of the animal or vegetable kingdoms; in the mineral kingdom, however, it is widely distributed, and occurs in immense quantity in rocks, and clays, and gems. It has been turned to many useful purposes in the arts, as in the manufacture of pottery and porcelain, and in mordanting fabrics. In spite of the abundance and the universal distribution of aluminium, and notwithstanding its importance in the arts, the chemical constitution of its compounds has received less attention than has been accorded to the compounds of some of the rarer metals.

The evidence as to the constitution of compounds, and the atomic weight of elements is twofold:—

a. Specific Heat.
b. Vapour Density.

a. Specific Heat. We know that equal weights of different elementary metals, heated to the boiling point of water, melt different quantities of ice; *e. g.*, 1 part by weight of silver melts twice as much ice as 1 part by weight of bismuth—the specific heat of silver is, therefore, twice that of bismuth. But, on the other hand, it is found that the atomic weights of these two metals, taken, say in *decagrammes*, melt the same quantity of ice; therefore we conclude that atomic weights of silver and bismuth have the same specific heat. Extending this experiment to other elements, we find that the weights capable of giving equal "melting power" will be for certain metals:—

Lithium	Li	= 7	Tin	Sn	= 118
Magnesium . . .	Mg	= 24	Mercury	Hg	= 200
Zinc	Zn	= 65	Lead	Pb	= 207
Arsenic	As	= 75	Bismuth	Bi	= 210
Silver	Ag	= 108			

The foregoing numbers are, then, the atomic weights of the above-named elements.

Now the amount of aluminium having equal melting power to 108 of silver is 27·5, not 9·2, nor 18·3, nor 36·7. The chloride is, therefore, not $Al' \, Cl$, nor $Al'' \, Cl_2$, nor $Al'''' \, Cl_4$, but $Al''' \, Cl_3$.

b. Vapour Density. The atomic weight of a metal will be the quantity contained in two vols. of the gaseous chloride. Thus two litres of hydrochloric acid, H Cl = 1 *crith** of hydrogen, H, + 35·5 criths of chlorine, Cl: the atomic weight then of H = 1. And so

* *Crith.* The term crith has been lately introduced into chemical language. A crith of hydrogen is the weight of one litre of that gas at the standard temperature and barometric pressure. One litre of chlorine contains consequently 35·5 criths, 35·5 being the atomic weight of that element, and so on with other gases.

with other elements. With regard to aluminium, Deville has shown that two litres of gaseous chloride of aluminium = 55 criths of Al + 6 times 35·5 criths of Cl :—the atomic weight then of Al = 55, and the formula of the chloride is consequently $Al''''''\ Cl_6$, or $Al\!l\ Cl_6$.

Which determination of the atomic weight is right? Specific heat says one thing, vapour density another. But take the vapour density of another aluminium compared. Dr. Odling finds that two litres of aluminium methide, or ethide vapour, contain only 27·5 criths of aluminium; $Al'''\ Cl_3$ is, therefore, the right formula for the chloride and the atomic weight of Al = 27·5. This determination of the atomic weight by the vapour density of the new bodies thus confirms the results deduced from the specific heat of the metal itself. The vapour density of the chloride is not an adequate guide, being, as is the case with some other chlorides, anomalous.

In the concluding part of his discourse Dr. Odling illustrated the properties of the new substances made by Mr. Buckton and himself; namely, the aluminium methide, a compound of the organic radicle methyle ($C\ H_3$*) with aluminium, thus—$Al\ Me_3$ †; and aluminium ethide $Al\ Et_3$; Et representing ethyle, $C_2\ H_5$. These bodies occur, according to the temperature, either in crystals or in the liquid, or in the gaseous form: they are spontaneously inflammable, and explode under water. They are made by digesting the mercury compounds of methyle and ethyle respectively, with aluminium clippings.

NOTES AND MEMORANDA.

Meteor observed at Sea.—The following communication has been received from Joseph D. Dickinson, Esq., late 4th Regiment, and was written by him on the voyage to New Zealand, a few days before landing :—" On board ship 'British Trident,' October 23rd, 1864. We were yesterday in lat. 46° 49′ south, and long. 124° 12′ east, when, at about ten o'clock p.m., our attention was drawn to a very brilliant streak of pale light, extending right across the heavens from east to west. The side of the streak next to the south was well defined, that next the north not so well. In breadth it was about 7°, but narrowed a little, and was less brilliant towards the extremities. When I first caught sight of part of it, between two sails, I thought it was the tail of a comet, which, indeed, it much resembled; but when I saw more of it I knew I was wrong. There was at the same time a clear pale light in the south, from which I could, for a short time, distinguish a very faint ray extending upwards. This part of the heavens was, however, soon obscured by a thick bank of clouds, which rose up so as effectually to prevent our seeing anything more in that direction. The streak overhead lasted (sometimes fading a little, and then getting bright again), until quarter-past eleven p.m., when it appeared to break up into a number of streaks like tails of comets, extending from the southern side of the original streak in an E.N.E. direction, the wind at the time being W.N.W. These remained very bright for a few minutes, and then faded away. During the whole time there were no clouds to be seen, except the

* C = 12. † Al = 27·5.

bank in the south. I supposed the appearance above described to have been the Aurora Australis; but the captain and officers of the ship, as well as those passengers who have been living in the southern hemisphere, all said that they had never seen anything like it before, and that all the auroras which they had seen showed bright lights of many different colours, constantly shifting, but never this steady pale light.—[It must have been an exhibition of the aurora: the colours often seen are not essential to the phenomenon].—Mr. Alexander S. Herschel, to whom the above description was shown, has kindly sent the following account of a somewhat similar appearance, described by Dr. J. D. Hooker, *Himalayan Journals*, large 8vo edition, vol. ii. p. 385:—"1848, Feb. 14, nine p.m. Baroon (east bank of the Soane River, lat. 24° 52′ N., long. 84° 22′ E., alt. 345 feet, bar. corr. 29·751, temp. 62°, dew point 41°0. Calm, sky clear, moon ¾ full, and so bright that the milky-way and zodiacal light could not be discerned, and the stars and planets were very pale). Observed about thirty lancet beams rising in the north-west, from a low luminous arch, whose extremes bore W. 20° S., and N. 50° E.; altitude of upper limb of arch, 20°; of the lower, 8°. The beams crossed the zenith, and converged towards S. 15° E. The extremity of the largest was forked, and extended to 25° above the horizon in the S.E. by S. quarter. The extremity of the centre one bore S. 50° E., and was 45° above the horizon. The western beams approached nearest the southern horizon. All the beams moved and flashed slowly, occasionally splitting and forking, fading and brightening. They were brightly defined. At ten p.m. the luminous appearance was more diffused. No beam crossed the zeinth, but occasionally beams appeared there and faded away. Between ten and eleven the beams disappeared from the S.E. quarter, and the longest and broadest beams were near the N. and N.E. horizon. Those who were witnesses of the appearance considered it a brilliant display of the aurora." Mr. Herschel observes that in this case the beams ruled the sky from N.N.W. to S.S.E., and nearly from horizon to horizon: *i.e.* nearly north and south, and nearly horizontal, which is an uncommon appearance.

Temperature and Development.—M. Dareste has communicated to the French Academy the results of experiments on the development of embryos in fowls' eggs, at comparatively low temperatures. He finds that the germ does not become an embryo below 30° C. or 86° F. Embryos formed between 30° and 34° C. grow very slowly, and none are hatched. Many of the embryos became monstrous, some presenting anomalies in the head, others were like cyclops, and these often exhibited two rudimentary hearts.

Stool for Astronomers and Artists.—In using telescopes of three or four inches aperture, mounted at 5½ or 6 feet from the ground, a great many objects are conveniently seen when the observer is seated on a firm stool capable of adjustment, varying its height from 19 to 31 inches. For this purpose, Mr. Slack has had a stool constructed of oak, well dovetailed together. It consists of two parts. The outer part, 18½ inches high and 11 by 13 wide, is like an oblong box, open at top and bottom. Into this slides a similar box, closed at the top by a seat slightly overhanging the sides, and half an inch thick. On opposite sides of the outer part are cut two slits three-eighths of an inch deep, and three inches wide. These slits are two and a half inches below the top, and exactly correspond with each other. On opposite sides of the inner parts there are two sets of slits of the same dimensions. Each set contains thirteen slits, and when the inner part is dropped down as far as it will go, a bar of oak three-eighths of an inch thick, and three inches wide, passes from side to side through the two outer slits, and through the top slits of the inner sets. From centre to centre, the inner slits are one inch apart, and when the stand has to be raised, the slide is pulled out and pushed in again through the slits, which correspond with the elevation required. A little practice enables this to be done in a moment, even in the dark, and the stool is quite firm at its greatest elevation. A stool of this kind must be thoroughly well made, or it would be a ricketty, troublesome affair. The one described, made by a first-rate workman, cost 35*s.*, and has been in use for several months, leaving nothing to be desired. It is evident that a stool of the same description would often be very convenient for artists.

Production of Diabetes by Cold.—The *Proc. Roy. Soc.*, No. 70, contains a paper by Dr. Bence Jones, on the production of diabetes in rabbits by surrounding them with ice, and thus arresting the processes of oxydation going on in their bodies. The urine of rabbits naturally contains a little sugar, but the quantity was notably augmented by exposing them to a low temperature.

Invisible Radiation of Electric Light.—Professor Tyndall describes the distribution of the heat rays in the electric spectrum, in the *Proc. Roy. Soc.*, No. 71. Melloni, Franz, Müller, and others, found the heat to augment from the violet to the red, while the maximum effect was beyond the red, and at a distance from the red, in one direction, equal to that of the green of the spectrum in the other. The augmentation of temperature beyond the red is sudden and enormous. If the amount of heat in different parts of the spectrum is indicated by a curve following its increase or decrease, a steep peak must be described beyond the red, and this peak is much steeper and more abrupt in the electric than in the solar spectrum. Professor Tyndall supposes that the aqueous vapour in our atmosphere has toned down the solar rays. A solution of iodine in bisulphide of carbon stops all the light rays, and allow the heat rays to pass freely. Professor Tyndall converges the rays of an electric lamp by a concave mirror, stops the light by a screen of the iodine solution, and ignites wood, lights cigars, etc., in the dark focus of the non-luminous rays.

Nature of Sun Spots.—Messrs. De la Rue, Balfour, Stewart, and Benj. Loewy, have communicated to the Royal Society (see *Proc.*, No. 71) the results of numerous observations on solar spots. The majority confirm the belief that the umbra of a spot is at a lower level, or nearer the crater than the penumbra. The faculæ, or light-streaks, appear to be above the spots at a high elevation in the solar atmosphere. The bottom of the spots is supposed to be of a lower temperature than the photosphere, and this luminous photosphere is considered not to be composed of solid or fluid mattter, "but rather of the nature of a gas or cloud." Observations of a sun spot, by Professor Phillips, of which details will be found in same publication, detected perspective appearances, which showed that it was, on a whole, not sunk very much below, or raised very much above, the general level of the region. He thinks the black nuclei of spots the sun's body; the penumbra that body partially seen through the atmosphere. The faculæ, he supposes, transmit rays which have acquired a higher refrangibility than that with which they started.

Mr. Huggins on the Orion Nebula.—In Mr. Burr's article on Celestial Chemistry, it was stated that Mr. Huggins had obtained a gaseous spectrum from the Great Nebula in Orion. Since then a paper on the subject appeared in the *Proc. Roy. Soc.*, No. 71, containing some fresh particulars. Nebulæ 4760, 4678, in Sir J. Herschel's catalogue, which are "well resolved" by telescopic power, give continuous spectra, indicating their difference from other nebulæ, which give only certain lines of light, indicating that they are gases producing rays of one degree of refrangibility. When the Orion nebula was examined, the light from the brightest part near the trapezium was resolved by one prism into three bright lines, in all respects similar to those of the gaseous nebulæ described in our January number. When the stars of the trapezium were brought upon the slit, continuous spectra were obtained. The whole of the nebula that was bright enough to be examined, gave the same spectrum of three bright lines only. Thus the detection by large telescopes, in this or other nebula, of an assemblage of minute points of light, can no longer be accepted as proof that the object consists of true stars. Mr. Huggins remarks, "it is worthy of consideration that all the nebulæ which present a gaseous spectrum, exhibit the same three bright lines; in one case only, 18 H. IV., was a fourth line seen." Mr. Huggins' theoretical suggestions are, we think, open to some objection. He says, if we suppose the gaseous substance of nebulæ, the nebulous matter which, by condensation, forms stars, "we should expect a gaseous spectrum, in which the groups of bright lines were as numerous as the dark lines due to absorption, which are found in the spectra of stars." Are we not equally entitled to say we should *not* expect anything of the kind? If the nebulous theory of star formation be accepted, we

should expect the nebulous vapour to consist of matter in a much simpler form than most of the vapours and gases we are acquainted with, and it would only be as condensation progresses that the chemical compounds which we know would be produced. We agree with Mr. Huggins that it would be an improbable supposition to consider the nebulous spectra of three bright lines indicates matter in its *most* elementary forms. The supposed ether of space may be still more elementary, but the nebulous matter very elementary, as compared with other matter in a much more condensed state. Mr. Huggins inclines to the opinion that the gaseous nebulæ "are systems possessing a structure and a purpose in relation to the universe, altogether distinct, and of another order, from the great group of cosmical bodies to which our sun and the fixed stars belong." With great admiration for Mr. Huggins' brilliant discoveries, and great respect for his scientific knowledge, we should, in the present state of information, reject this hypothesis. It seems to us more likely that we must enlarge our chemical theories to take account of the probable nature and properties of matter in so *unterrestrial* a condition as that of the nebulæ, than that we shall be compelled to assume those nebulæ to stand aloof from the general scheme of construction, change, and reconstruction, which apparently enfolds all the bodies in the physical universe.

Professor Phillips on Mars.—In *Proc. Roy. Soc.*, No. 71, Professor Phillips remarks that as the relative solar influence on the Earth and Mars, arising from the different distance of the two bodies, would be as 100 on Mars to 231 on the earth, the surface of the more distant planet might be expected to be in perpetual frost, which is not apparently the case. He considers that its atmosphere may obstruct radiation of dark rays to a greater extent than our own, without differing very materially from ours. He adds: "It seems, however, requisite to suppose a greater communication of heat from the interior of the planet, for otherwise the additional vapour, to which the warming effect is in the main to be ascribed, could not, probably, be supported in the atmosphere." He likewise mentions a curious result arrived at by Mr. Main. "Computing by the known rotation velocity, and the admitted measures and mass of Mars, its ellipticity should be about $\frac{1}{300}$. Mr. Main's observations with the splendid Oxford heliometer give as the most probable result $\frac{1}{37.59}$ for 1862." Professor Phillips found at the late opposition, that the substances round the south pole appeared less extensive than in 1852, and were not really observable with distinctness, except on a few evenings. The axis of Mars being at this opposition nearly at right angles to the line of sight would prevent much snow being seen even if it existed.

The Suez Canal.—M. Lesseps states, that since the 1st of January a daily communication has been established between the Red Sea and the Mediterranean. A boat, containing twenty or thirty people, was tugged by a steamer through the canal in twenty-four hours.

WHITE-SPORED MUSHROOMS.
(The Ring Bearers.)

1.—Agaricus cæsareus, Scop.
2.—Agaricus excoriatus, Schæff.
3.—Agaricus cèpæstipes, Sow. var.
4.—Agaricus mucidus, Fr.

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NOTES ON FUNGI.—No. II.

WHITE-SPORED MUSHROOMS (THE RING-BEARERS).

BY THE REV. M. J. BERKELEY, M.A., F.L.S.

(*With a Coloured Plate.*)

Of the six divisions of the great genus Agaricus mentioned in my last article, that which is characterised by the spores or reproductive organs being white is one of the most important, from the number of esculent species which it comprises, though it does not include the true mushroom. Only one or two indeed ever appear in our markets, but the merits of several of the species are becoming more widely known every day, and on the Continent they yield an abundant supply of good and wholesome food.

The white-spored mushrooms, or Leucospori, are divided by Fries into eight sub-genera, Amanita, Lepiota, Armillaria, Tricholoma, Clitocybe, Collybia, Omphalia, Mycena, and Pleurotus, on each of which I shall have to make a few observations. The three first and a few species of the last division are in general characterised by the presence of a veil covering the gills and stretching from the stem to the edge of the pileus, either in an ascending or descending direction. It is true that in one section of Amanite there is no veil, but then there is a distinct universal wrapper, or, as it is called by mycologists, a volva, which alone separates the division from all the rest, for the universal veil in Lepiota is not distinct from the pileus. The first question then to be asked on examining a white-spored Agaric is, has it, or has it not a volva, distinct from the cuticle of the pileus. If the former is the case, we have an Amanita, and may at once proceed to discover to what species it belongs.

There is, indeed, some difference in the appearance of this

volva. Sometimes it is a distinct white membrane, which in an early stage covers the whole pileus, and which, as the plant swells, bursts and appears at the base of the stem as a lobed cup; sometimes a large portion of it remains on the pileus in the form of mealy or wart-like patches, while the free portion below is a mere rim; but sometimes, again, it is incorporated more or less with the base of the stem, being entirely irregular.

Now, every one who has paid the slightest attention to Agarics must be acquainted with the magnificent fly Agaric, which is such an ornament to our birch woods, with its bright scarlet pileus studded all over with white or yellow warts, and there is such a strong family likeness between the species that it is almost impossible to confound an Amanita with a species of another section.

Amanita * contains some of the most dangerous fungi, but it also comprises a few of the very best. *Amanita cæsarea* (Fig. 1), distinguished by its bright smooth pileus free from warts, its capacious volva, and its yellow gills, is confessedly one of the most delicious of fungi, and is the pride of southern markets, where it has been known from the times of the Romans, and is the Boletus of the Satirists, as from its pre-eminent qualities it was often made the vehicle for poison. This lovely species, which has a very close ally in the Himalayas, north of Calcutta, may some day reward the research of mycologists in the south of England or Ireland, as is the case with the coral-red Clathras. There is a species with white gills in Italy, *Agaricus ovoides*, which closely resembles it, which appears to possess almost equal excellence.

In England we have one or two which may be eaten when young, but it must be with caution, as the sub-genus contains several poisonous species. *Agaricus vaginatus*, which has no ring, and is remarkable for its highly developed volva, and the grooved margin of the pileus, which assumes various colours, though it has an evil report when fully grown, may, according to Vittadini and others, be eaten when young. It is, however, seldom abundant enough to be of any great consequence as an esculent. Dr. Badham considered *Agaricus solitarius*, which sometimes grows to an enormous size, as excellent, if in good condition, and this comprises, perhaps, all of the section which may be eaten with impunity. I should be sorry to sanction a trial of our more abundant species, even when young, as *Agaricus rubescens*, which sometimes grows in enormous quantities, especially in fir woods, where its red stains at once distinguish it. *Agaricus virosus* bears its own

* From ἀμανῖται, a name given to certain poisonous fungi, by Dioscorides and Galen.

bad character in its name, and *Agaricus excelsus* has almost as bad a report as *Agaricus muscarius,* whose narcotic qualities are notorious, a single specimen being quite sufficient to produce a very unpleasant degree of intoxication, for which purpose it is dried by some tribes in the north of Asia.

The species of the section, as said above, are recognized without difficulty, and without experience it is far better to abstain from so insidious a group, for we are sure not to meet with the true or white oronge, *A. cæsareus* and *A. ovoides,* except in the far south.

There is one small division to which the English *Agaricus megalodactylus* belongs, which may prove a puzzle, because the volva at length entirely vanishes, leaving the pileus smooth; but an examination of young specimens will at once decide the matter, and will distinguish it from the second sub-genus Lepiota, which derives its name from the scales (λεπὶς), which are so highly developed in most of the species.

Now, as said above, there is a universal veil in Lepiota as well as in Amanita, but in the latter it is evidently quite distinct from the cuticle, however closely united it may be, while in Lepiota it is completely confluent with it, and with it often breaks up into scales. There is another character besides that of the possession of a universal veil in which the two sub-genera agree, which is, that the portion of the pileus which bears the gills (hymenophorum) is perfectly distinct from the stem; and it is with reference to the distance of the base of the gills from the apex of the stem that they are said to be remote or approximate, and not to their distance from each other, as the student might at first suppose.

The portion of the universal veil which separates from the pileus leaves a more or less distinct trace on the stem, which is moreover encircled with the partial veil, which is concrete with the former or distinct, and either moves freely up and down, or is permanently fixed. The ring is said to be superior when it originates and hangs down from the top of the stem; inferior when it grows like a sheath upwards to the edge of the pileus; medial when its origin is distinct in neither direction. In a few species, there is a viscid coat; and in these consequently there are no scales on the pileus, though the stem is occasionally floccose.

Some of the species of this division are found occasionally in great abundance, as the tall *A. procerus,* which has the strongly bossed pileus covered with rough, coloured scales, and the bulbous stem spotted like a snake. It is one of the best of our Agarics, and yields an excellent, though not abundant ketchup. It is occasionally sold in Covent Garden Market; and *A. rachodes,* which is closely allied, but known at

once from every part turning a deep red when bruised, is a welcome addition to the basket of the mushroom gatherer, who is not very particular what he gathers so long as it yields a dark juice, though it is not so good for food, if indeed it is always perfectly safe. Three or four closely allied species occur in groves and pastures, the esculent characters of which have not been fully ascertained, but they are all probably harmless.

A. procerus and its more close allies, of one of which, *Agaricus excoriatus,* we have given a figure (Fig. 2), attain a considerable size. There are, however, several smaller species, some of which are doubtless wholesome, but some, as indicated by a nauseous smell, of dangerous character. They are, however, too small, and occur in too small quantities, to make them of any great culinary importance. I must not, however, omit to notice those which occur occasionally in large masses in hothouses, especially where spent tan is used. They are mostly extremely pretty, but of very suspicious quality, and one or two are probably of exotic origin. *Agaricus cepæstipes* occurs in Java in very nearly the same form as that figured in Sturm's *Deutschsland Flora,** and it is probable that *A. meleagris* was also originally exotic. *A. rachodes* occurs occasionally in hothouses, where it is very ornamental. The scaleless stem forming a contrast to the very scaly pileus is very striking, and indicates apparently a specific difference from *A. procerus.* It must, however, be confessed that intermediate states occur which it is difficult to refer to either.

We now come to a third division; Armillaria (named from Armilla, an armlet), which has a well-developed ring, though there is no universal veil. The division is, however, rather artificial than natural, and the species might be classed with the three following divisions. Here the hymenophorum is not distinct from the stem, but confluent with it. If then, as Fries well remarks, the divisions are to be considered as generic, Armillaria must be rejected, and the species merge in Tricholoma, Clitocybe, and Collybia.

The species are not numerous, and in this country cannot be considered as of much importance in a culinary point of view. *Agaricus melleus,* however, which is one of our most abundant species on stumps where trees have been cut down, and which is known by its well-developed ring and honey coloured scales, is much eaten in some parts of the Continent under the name of Halimasch. It is, however, a detestable species, producing an unpleasant constriction of the œsophagus, and

* Fig. 3 is copied from a drawing made by Herr Van den Bosch in Java, and forwarded to me by Dr. Anderson from the Calcutta Botanic Garden, amongst many other interesting matters.

in all probability in many cases must lead to unpleasant consequences. Salt and vinegar, which are so much used in Eastern Europe, especially in Russia, as a pickle for Agarics, neutralise, in all probability, the deleterious alcali. There is no chance, indeed, of any one in England, except by way of experiment, cooking so uninviting an Agaric, which may therefore be dismissed without any scruple. In Sweden it is justly neglected, and Fries does not give it a word of commendation, though he says that it is esculent.

A very beautiful species, *A. mucidus* (Fig. 4), occurs on beech trees in the southern counties, being a sure indication of imminent decay. The viscid, pure white, or slightly ash coloured pileus and distant gills, together with the highly developed ring, readily distinguish it.

The figures of *Agaricus cæsareus* and *excoriatus* are copied from Vittadini, and that of *A. mucidus* from the Flora Danica, as my own original sketches of the two latter species are not at present accessible.

LONDON BIRDS.

BY SHIRLEY HIBBERD.

Though London grows at such a rapid pace, that it threatens soon to cover the greater part of the county of Middlesex, nature is very beneficent, and has hitherto resisted the complete eclipse by dirt which the speculative builders appear to have had in contemplation. It was said by Leigh Hunt (or somebody else), that you could not proceed far in any direction through the City of London without seeing a tree; and to that it may be added, that you can scarcely proceed a single yard anywhere in the City, or in parts more close and crowded, without seeing a bird. London is, indeed, far richer in birds than it deserves to be. The municipal authorities and the parochial and district boards rarely expend a penny or bestow a site for the planting of a tree, the open spaces are for the most part disgracefully filthy and desolate, and consequently there is little encouragement within the town itself for birds of any kind. In the suburbs it is otherwise. Nowhere in all England is gardening pursued with so much ardour, and generally with such good taste. As we proceed outwards from London, no matter in what direction, we see the gardens beautifully planted; and the soil being everywhere good, trees are plentiful and birds abound. A few birds, however, seem to be

specially adapted, not merely for London as viewed from without, but for London *par excellence*, that is to say, for the smoky, noisy, almost treeless City; with these for pioneers, nature invades the Stock Exchange, the Court of Aldermen, the Bank, and all the railway termini, as if to say, "Shut me out *if you can*."

Of what race or descent, of what origin or history, are the Guildhall pigeons, I know not; but if any naturalist inquires after City birds they claim first mention, and might well have a place in the civic emblazonment of arms. The first birds it was ever my lot to keep, when a very small boy, were a pair of pigeons that were trapped for me by a young friend, who lived within a stone's throw of the Guildhall. They were sent in a basket to Stepney, and there I made for them a large cage by placing laths in front of an empty box, and the box was hung up in the garden close to the kitchen door. In due time a pair of young pigeons came forth, and the *Penny Pigeon Book*, which I used to pore over in hope of learning the whole art and mystery of the pigeon fancy, told me that as soon as they had young I might allow them to fly; they would never leave the spot where they had young to care for. So, on the first day of the chicks coming out of their eggs I drew away one of the laths, and away went both the birds. They circled round to reconnoitre, as is the custom of pigeons, and then they took a direct flight westward, and were never seen in Stepney more. My friend averred that he saw them come home, for the young thief (he is now an eminent citizen) spent all his time watching the Guildhall pigeons, and to confirm his statement, he offered to entrap that identical pair again any day if I would have them. But I never did have them, and never wished for them. The little ones died in my lap, wrapped up in flannel; and that was the first and last of my experiences in pigeons. It is very rarely any one has the audacity to trap or harm a City pigeon. They are as sacred as storks in Holland, and the birds of good omen that built in the temples and residences of classic Greece. They are the pets of policemen and railway porters, and woe to any one found engaged in devices for their destruction. Those met with elsewhere in the City, appear to be colonies originally sent out from Guildhall. There is a large colony at the terminus of the South Eastern Railway at London Bridge, and greatly do the porters and the drivers of public vehicles rejoice in them, and kill time when waiting for incoming trains by robbing the horses' nosebags to feed the pigeons. At the Royal Exchange there is a small colony, but it is fast increasing. Their breeding-places are principally the capitals and cornices, but they are not particular. Any place that affords a little

shelter suffices, for safety they seem to have little care; familiarity with the noise and bustle of the City renders them fearless, and you see them foraging under the heels of horses and along the line of cab ranks with much the same nonchalance as those mysterious ragged urchins who swarm about the pavement of the Exchange, and live no one knows how.

Next to the pigeons, the City sparrows claim attention. They are a sooty race, inured to City life and usages, and exhibit in their habits an indefatigable determination to "get on." During the mid-day hours, when Cheapside is in a constant tremor with the clatter of hoofs and vibration of wheels, the sparrows are as busy as the people. If there be but for an instant a blank space in the roadway, down drop half a dozen and forage with furious impetuosity among the droppings of horses for scraps of undigested grain, and for the flies that settle on the disjecta even more quickly than themselves. You may observe that they calculate almost to an inch and a second their escape from the next team, alighting on the nearest window sills, and waiting to descend again the next moment any blank occurs. There are very few City houses that afford accommodation for sparrows to nest. The builders take the best care to prevent their gaining a settlement anywhere, for they damage the properties they select for their habitations much more than is generally supposed. The boxes placed at the summit of water spouts, where the rush of water from the roof finds its way from the slope to the perpendicular, are their usual nesting places; and when the next heavy rain comes the nest stops the way, and the water leaps over the top of the spout and comes down sputtering on the pavement in an inky flood. Then a plumber is sent for, a ladder is placed, and presently a conglomeration of hay, straw, rags, shoe-strings, bits of paper, tufts of hair (human), strips of parchment, corks, bristles, and other rubbish is dragged out, with mayhap, if it is the right season, eggs or callow young, and an end is unceremoniously made of Mr. and Mrs. Chirk's establishment; and that removed, the water betakes itself to its proper channel. But the majority of the City sparrows build about churches and large public buildings. The sparrow is a public character, and loves the neighbourhood of boards, vestries, committees, and people who dine gloriously; for these happy folks have not only plenty of brickwork, and warm chimneys, and gable ends, and cornices, and architectural pockets; but they have also a few trees or a bit of garden hard by their places of assembly, and these suit the sparrow, who loves a bit of country even when gorged with refuse from the "Albion." The love of sparrows for trees is well known by Londoners. There are certain spots

especially favoured with patches of green umbrage, and where-ever there is one fine tree or an imposing group of trees, there also will be established what in London is termed a "Sparrow's Chapel." In the garden of the Bank of England are some noble lime trees, and soon after daybreak a sweeter music issues from their leafy branches than the chink of coins which comes afterwards in the penetralia of that august establishment. At the corner of Wood Street, where there was once a rookery, there is now a grand chapel in the tall plane tree there. The trees at the foot of Southwark Bridge (Middlesex side) resound with the chirping of a thousand sparrows, every morning and evening all the year round. There is a small twitter among the plane trees of Bucklersbury, but it is too small to give the place any claim to be called a chapel. Tower Hill is great in sparrows, and the Tower itself is a sort of Cantelo hatching apparatus for the brood of impudent foragers that almost deserve to be described as mice with feathers. But there are two grand sparrow chapels (there may be hundreds): one in Wilton Crescent, Belgravia, where there is a tree that affords a thousand perches for a million chirpers; the other is a fine old poplar at the northern extremity of Goswell Road, at the junction of Goswell Road and City Road, fifty yards south of the Angel, Islington. At dusk and day-break, these two spots are like fairyland. The sparrow is no songster unless taught, and then a tolerable musician; but the untaught melody of the myriads that assemble in these trees for matins and vespers is by its volume almost sublime. They seem to come from all quarters at the hour of meeting, as pertinaciously and as solemnly in garb as Quakers, but the very antipodes of that sect in volubility; and they literally make the welkin ring spite of the roar and rumble of cabs and omnibuses. Their song is all to one tune, *simul et semel;* and this they sing with all their might, and, like the great Kœnig of brazen memory, the compass is limited to two or three notes.

One can understand that pigeons and sparrows are at home in London. The fact is, the place is full of food for them. But it is hard to understand why rooks should cling so pertinaciously to their ancient homes. No one ever saw rooks build on housetops. They must have trees. And in a great many of the spots where large trees still remain, there rooks do still congregate. Yet among the rookeries there is no parallel to the misery which is too common a characteristic of those abodes of the outcasts of the human family, which strangely take the same name: no, the rookeries of Gray's Inn and Spring Gardens are agapemones, they are abodes of peace and plenty; no one hurts the rooks in London; the only smell of

gunpowder they are familiar with is the occasional curl of smoke from a volunteer review, and to traps and gins and poison, aye, to persecution of every kind, they are happy strangers, held in a kind of sanctity, as precious living relics within the town of the glorious world of greenness that lies beyond. The rookery in Holland Park, Kensington, one of the most ancient in the land, is still in fine feather, and the clamour there is just now being renewed, and the air resounds the whole day long with the harsh "caw, caw," that tells unmistakeably of their anti-malthusian propensities. In that delightful collection of personal reminiscences, *London Scenes and London People*, by "Aleph," there are some amusing anecdotes of rooks and rookeries in London. We are told of the "famous rookery in Carlton House Gardens; but when, in 1827, the trees were cut down, the rooks emigrated to a plantation at the back of New Street, Spring Gardens. * * * There is a rookery near Kensington Palace. Taking a long stride into the heart of the City, we find a rookery in the south burial-ground of St. Dunstan's in the East, Tower Street. Before the old church was pulled down, there were at least twenty nests; and the kindly parish officers annually supplied them with osier twigs and other necessaries for constructing their homes. When the church was removed, in 1817, the disturbed rooks took refuge at the Tower of London, and rather ambitiously built in the White Tower;* yet they were unable to reconcile themselves to the change; and no sooner had the workmen left their former haunt, than they returned to their ancient quarters. In 1849 the kindness of the authorities was again extended to them, their nest-making being aided by Mr. Crutchley, the assistant overseer. They built in some venerable plane trees." It is rather odd that the author of *London Scenes* should know of the rookery that once existed in the large elm trees behind the Ecclesiastical Court, Doctors' Commons, and yet not know of the last chapter of its history. A mischievous fellow living in a ten-pair back overlooking the rookery, furnished himself with an air-gun, and from time to time popped off the rooks with noiseless missiles. In another ten-pair back dwelt an observant philosopher, whose curiosity was awakened by seeing the rooks fall from time to time without visible or audible cause. That observant philosopher communicated to the Royal Society that rooks were subject to the *falling sickness*, and to this disease, of which the air-gun was the unknown predisposing cause, is to be attributed the extermination of the rooks that made a clerical "caw" from their clerical throats in that sanctuary of

* Which belies the remark of mine just above, that "No one ever saw rooks build on housetops."

ghostly intentions. The most noted of all the City rookeries was the plane tree at the corner of Wood Street, Cheapside. It is a rookery no longer; when the rooks finally quitted it no man can tell. I tried to discover when the rooks were last seen there by a query on the subject printed in the *City Press*, but there was no response. Mr. Alfred Smee, in his volume on *Instinct and Reason*, says there were four nests there in 1850. I saw *birds* there in 1858, but have never seen them since; but yet at the present time one nest remains, and it is, I believe, annually occupied by sparrows.

The transition from rooks to daws is easy enough, for they are boon companions. Yet daws are nowhere seen in the heart of London, except at the Tower, where there are always a few. In the immediate suburbs, however, daws are tolerably plentiful wherever there is an old architectural pile, be it church, mansion, or what else, for them to nest upon. Our pretty old village church, at Stoke Newington, has a few daws for inhabitants, and, from the noise and fuss they make in the early part of summer, one might think the very atmosphere to be made of daws, so clamourous are they, and so active in rushing to and fro. I know that they watch for my small annual crop of walnuts—I have but one walnut tree—and generally manage to carry off all the nuts just at that critical moment when they are ripe enough to be eatable, yet not ripe enough for use. It is the same with my neighbour, Mr. Dobinson. He has a fine tree that bears plentifully, and the daws gather the produce as regularly as a landlord comes for his rent. I expect the folks at Kensington are equally unfortunate in walnut culture, for, last summer, I saw a lot of daws sailing along over the houses in High Street in the direction of the church; and I remember that, when a boy, at Stepney, we used to throw cricket balls at the church clock, and now and then get a daw's nest by climbing up the old flint buttresses, saying the Lord's Prayer backwards, at the same time, to raise the Devil, a sort of killing two birds with one stone, though the "killing" was, in one case, a quickening, and we used always to drop the nest with fright as soon as we had made a clutch at it, fancying we heard the footsteps and smelt the sulphur of the darker party as we finished the incantation. The jackdaw is, in fact, a common London bird, though a stranger to the City.

Now that we have got to the suburbs, birds abound. In all the gardens, especially on the south, west, and north, the song thrush is one of the most plentiful of birds. On the eastern side of London song birds are rather scarce, though in a few favoured spots, as at Bromley by Bow, and in the more rural parts of Homerton and Hackney, the thrush is still a

constant resident. The blackbird is more scarce, yet at Stoke Newington, Stamford Hill, and Highgate, on the north; and at Dulwich, Battersea, and Wandsworth, on the south; it is commonly seen and heard, and builds and breeds without fear, wherever there is a sufficient amount of seclusion. Westward I have never seen the blackbird nearer London than Uxbridge, and beyond that point blackbirds are almost as plentiful as blackberries. The storm cock is a rare bird everywhere near London, but is occasionally seen at Stoke Newington. As for the robin, it is not a London bird in the same sense as a haymaker is not a Londoner. But as you may see haymakers in London, so you may see robins; its indomitable pluck and its solitariness of habit will carry it anywhere. Robins are seen among the hay-carts at Whitechapel, Smithfield, and Cumberland markets, in all the squares, in Lincoln's Inn, Gray's Inn, and other gardens; in the open roadway of Farringdon Street, Ludgate Hill, the Strand, and Blackfriars Road; nay, I once saw a robin on a lovely autumn afternoon perch upon the edge of a tombstone in St. Paul's Churchyard, and trill out a carol as sweetly as in any rural nook at home; and I think I may say, that of all the crowd then within seeing and hearing, I was the only one that saw and heard, for when the bird ceased, and I turned round to pursue my way, there did not appear to have been a single soul conscious of the angel visit but myself.

I am afraid that at this point we have done with true London birds. Yet it is hard to quit the subject. I call to mind that here (Stoke Newington), one of the commonest and most welcome of songsters is the hedge accentor (*Accentor modularis*, Cuv.). I never see it in the squares or real London gardens, yet it abounds in all the suburbs, wherever in fact there are gardens sufficiently large to separate houses by the distance of a hundred yards or more, if those gardens contain old hedges, or clumps of scrub, and wilderness. So with the wren, common enough in all real gardens, I never saw it nearer town than Pentonville, and there I have seen it with my own eyes. But very scarce near London is the fine crested wren, it is indeed a *rara avis*.

Among the visitants, the blackcap must take precedence for plentifulness. It is the precursor of the nightingale, and tells us that surely spring is come at last. At Dulwich, Hornsey, Kensington, and St. John's Wood the blackcap may be heard every season, soon after the last days of March; but it makes its way only into such of the more urban districts as enclose within their boundaries much rural scenery. Soon after comes the nightingale, who haunts many more localities of the London suburbs than the sleepy Londoners are aware. Strike

a radius of three miles from St. Paul's in any direction, except due east, and find at the termination of the radius some spot where there are tall elms, avenues of limes, orchards, or well planted gardens, and there, if you have ears, you may enjoy, any time during the month of May, the nightingale music. And here it occurs to me to make a special note on London songsters, that many true British residents are true migrants as to London; and all the true migrants come into song later near London than elsewhere throughout the land. I have heard the nightingale on the 2nd of April at Ringwood, Christ Church, and Minster, in Dorset; but never before the 15th or 20th at Stoke Newington. Shall I tell you that my heart leaps within me to know that the builders, spite of their desperate efforts, have not yet driven this queen of British song birds from our district. The nightingales sung in Lordship Road and over all our gardens, reaching as far back as Clissold's Park, all through the season of 1864, just as if builders were nonentities, and new bricks were as poetical as old trees, which we all know they are not. At Stepney, Bromley, Bow, Old Ford, and Stratford, the nightingale is unknown except in books. Elsewhere in the three-mile circle it is a constant visitant; it loves trees, is rarely hunted by cats (which destroy many thrushes), and has but one terrible enemy, and that is the birdcatcher.

The chaffinch, bullfinch, goldfinch, and linnet, are all migrants in and about London. They "come like shadows, so depart." Sometimes the air rings with the delicious but brief and monotonous song of the chaffinch for days together during May and June, and then we see no more of them for months. So with the bullfinch; they come down on the fruit trees like swarms of locusts, eat their fill, and go away fat as butter. As for the goldfinch, it is the rarest of all the finches near London; to see a group of them in late summer haunting a patch of thistles, or taking toll in the kitchen garden where there is a good crop of lettuce seed just ripe, is to have reasonable occasion for making an entry in one's diary. The linnets behave in a similar manner; they come in clouds in autumn, twitter, and disappear. Starlings come at all seasons, but most of all in winter and spring, and then always in large flocks, so that those who are wicked enough to shoot them may fill a bag at every pull of the trigger; that is if they can hit a haystack, which few cockneys are able to do. Now and then, during winter, I see that rare but lovely little oddity, the siskin. During the past few months several have appeared here, and as of yore always careless, merry, full of antipodean feats, and singing a song which is the most comical ever heard out of an avicular larynx. All the tits haunt the London suburbs, and

most interesting birds they are. The most common is the coal tit, a true acrobat, and a very sociable, innocent creature.

Swallows make their way pretty well into the heart of London, but not as in White's time are they met with in Aldersgate Street. There are nests to be seen in the older parts of Kensington, Lambeth, Kentish Town, and Stoke Newington, in plenty. Knowing the last-named spot I can tell you that in High Street, nearly opposite Church Street, there is a long file of swallows' nests under the coping-stones of the houses kept by Mr. Engisch, Mr. Davidge, Mr. Rumney, and thence northwards, and all the summer long the birds dart to and fro, over the tops of omnibuses and loaded wains, up the defile of Church Street, and over the beautiful expanse of Abney Park Cemetery, in apparent unconcern as to the noise and traffic. At the other end of Church Street, where the bold sweep of the New River, skirting Newington Park, makes "a silence all day long," you may see not only swallows, but swifts, and the nests of these latter are to be found on the upper parts of the fine old houses which overlook the Park at that spot; and thus within the distance (as the crow flies) of three and a-half miles of St. Paul's, are all the elements of rural life, and the aspects of the place are, as yet, those of a country village.

I should have concluded here had I not suddenly called to mind that the flycatcher has built in these gardens within three years past; that I used to trap redpoles in a field at Stepney, where is situated now the Metropolitan Cemetery; that, towards the approach of winter, and sometimes late in the spring, flocks of wild geese go over head, in wedge-shaped masses, crying as if for fear to find themselves in such dangerous proximity to smoky chimneys; that wood-pigeons often come over these gardens in flocks in autumn (a friend who resides at Tottenham, reckons on a few pigeon pies thereby every year); that fieldfares and redwings are seen in the open meadows every year in October and November, and fall victims to the fowler's gun; and that jays, magpies, crossbills, and hawks of all kinds are rarely or never seen at all within at least seven miles of the mighty Babylon.

AURORAL ARCHES.

It will be interesting to compare the accounts of the remarkable auroras recently seen in Scotland with descriptions of similar phenomena observed in other places.

The following passages are extracted from the *Daily Review* (Edinburgh) relative to an auroral arch, on Wednesday evening, the 15th February. They occur in two anonymous letters addressed "to the Editor."

1. *Penicuick.* "There was observed on Wednesday evening, the 15th February, an extremely rare phenomenon. About half-past eight on the evening in question an arch appeared, spanning the heavens from N.E. to S.W., and, what is unusual, its path was directly overhead for the first half hour. At either extremity it ended in a point about 8° above the horizon; and it gradually expanded until it reached the zenith, where it attained a breadth of about 5°. It was throughout brilliantly white, and contrasted remarkably with the blue sky. It was quite transparent except at the extremities, the stars shining through it; and the night being cloudless it was of singular beauty and grandeur. After the first half hour the arch began to decline towards the south-east, and by half-past ten it had lost much of its brilliancy." —C.

2. *Edinburgh.* "For volume and power of light the phenomenon of Wednesday night, the 15th February, far exceeded any single streamer of the Aurora Boreälis. The arch ran east and west, almost directly overhead, and stretching out to both horizons. The shape presented to the eyes of most persons was that of a dead straight line of brilliant light, at first yellow, but when it commenced to melt out of sight, of a silvery hue. It resembled a magnificent javelin horizontally suspended over the city, and produced at one end to a point in the horizon directly beyond Holyrood, at the other to Corstorphine Hill. The light at first surpassed that of the Comet of 1858, and there was an entire absence of motion in the luminous pathway; nor did it change its direction in the least in the last half hour of its existence, as was proved from bearings taken of it when first seen."—X.

Mr. J. Anderson, of Pratis, Fifeshire, in a letter to the *Fifeshire Herald*, exclaimed concerning the same aurora—"The wondrous beauty of the arch on Wednesday evening can hardly be described. It seemed a heavenly pathway of gold, shedding its brilliant light across the land, and leading

'Right onward to the golden gates of heaven.'"

Similar arches to that described were seen on the 29th

March, 1826, near Nottingham, and on the 22nd of March, 1841, at York, Durham, etc., when the height was estimated at more than 150 miles from the observations of Professors Chevallier, Phillips, and Stevelly (Lowe's *Treatise on Atmospheric Phenomena*, p. 144, et seq.). A similar arch was observed at Edinburgh on the 27th August, 1846, and an auroral band of the same kind observed by Mr. E. J. Lowe at Nottingham, and by Sir J. Herschel, at Hawkhurst, in Kent, on the 9th March, 1861, was estimated by the latter to have been eighty-three miles high midway between the two places, or over a place thirty miles north of London. Finally, a similar arch was observed by Professor Challis, at Cambridge, on the 21st February, 1862, which was vertical at Newark, in Lincolnshire, but other observations were wanting to determine the height of this arch.

It appears from these instances that such arches are most common in the months of February and March, and that they vary from 80 to 160 miles in their height above the earth.

We append a description, furnished by Mr. Herschel, of the appearance of the Aurora Borealis, as seen in Kent in the month of January last.

"1865, Jan. 28th, 7·35 p.m., Edenbridge, Kent. Two arches of the Northern lights appeared in the N.W., bright and colourless, the uppermost 7° or 8° above the horizon. Both preserved their brightness for a few minutes only, when the uppermost arch merged into the lower arch, resting together upon a black segment not more than 2° or 3° high. This black segment was cloud, for stars of the third magnitude setting behind it were immediately eclipsed.

"9·35 p.m., Hawkhurst, Kent. In four or five seconds of time an army of small streamers shot upwards from the border of the dark segment to a height of 10° in the north. These were yellowish, and covered an area of 10° or 12° in azimuth; they immediately began to course each other rapidly across the area from west to east, so as to run over the whole width of the area in less than one or two seconds, when, disappearing in the east, they were replaced by new streamers in the west. This running motion was renewed at intervals (for a few seconds at a time), until, in less than two minutes, the streamers subsided as quickly as they came, and disappeared. The arch and segment afterwards became less distinct, and no other display occurred until 11·30 p.m., excepting a wide diffuse streamer of brief duration at 10·50 p.m.

LEPIDOPTERA FEEDING ON FERNS.

BY M. G. CAMPBELL.

All along the shady side of my small garden, situated in the heart of the town, I have planted British ferns. Trees and a low wall screen them from the sun, as well as shelter them from wind. Early in the summer before last, I observed one of my lady ferns, *Athyrium filix-fœmina*, partially eaten by some insect. I searched for the depredator without success, until after giving the whole plant a thorough shaking, when two or three larvæ of the Great Tiger Moth, *Arctia caja*, fell to the ground. I took up two of them, and confined them in a box, covering it with green gauze, and there I fed them, not with my ferns though. I gave them what I knew they would eat, namely common plantain, *Plantago major*, as, accustomed for years to feed large numbers of lepidopterous insects, nocturnal and diurnal, the little furry-coated gentleman was no stranger to me; but, as my habit is, I like to prove everything for the satisfaction of others as well as myself.

In this cage they were by no means unhappy. They feasted on the fresh food supplied to them twice daily, increased in size, performed their due moults, changed into the pupa state when fully grown, and eventually evolved perfect imagoes of the *Arctia caja*, their gorgeous wings even more brilliantly coloured than usually found when roaming free, because they had been sheltered from the effects of wind and rain, and those wings are now displayed in one of the drawers of my cabinet, pinned on to its cork lining.

But what of my ferns all this time? After securing the first intruders, I did not again examine my ferns for three or four days, imagining I had all the mischief-makers in safe custody. But when about the fourth or fifth morning I went to look at them again, what was my consternation to find that my Athyriums, which had but a week before looked so lovely in the tender green of their lacy beauty, were completely eaten away, all but the primary rachis, and the branchlets, or secondary rachids issuing from it, which presented the appearance of so many dry threads, almost every atom of the soft, green, leafy portion of the plant being stript from it. Several fronds of a *Lastrea filix-mas*, which stood near, had also paid tribute. On the small bit which remained of the laminar portion several of the "Woolly-bears" were busily at work. I shook the ferns well, sweeping them in all directions with my hand, and the caterpillars fell from them in multitudes. They reminded me of nothing less than the plagues of Egypt. Morning

by morning for weeks myself and a servant hunted them out, and it is not too much to say that we often took from twenty-five to thirty of these intruders from a single plant, although the day before we had thought there could not be one left, so careful had been our search. I had been proud of my ferns, but my pride was sadly humbled; and all unwilling as I am to kill anything, I was obliged to allow these devourers to be crushed.

Last summer again the same thing happened. They came in incredible numbers. Before I was aware, they had again despoiled my Athyriums of every vestige of green, and in order to save my remaining ferns, we were compelled again to perpetrate a daily massacre.

Their plan was, each year, to attack the Athyriums first, then *Lastrea filix-mas*, after that the other Lastreas, then the Royal Osmunda, and when these failed, but not till then, they were not too dainty to try *Polystichum lobatum*. The Polystichums were always the last in requisition, they evidently preferred something more tender. I hope next summer they may take it into their heads to commit their depredations elsewhere than in my garden.

THE ACHROMATIC TELESCOPE, DIALYTES, AND FLUID LENSES—NEBULA—DOUBLE STARS—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

In several previous papers we have endeavoured to give a tolerably comprehensive idea of this beautiful invention; but a few particulars, not unworthy of notice, yet remain.

The chief impediment to the manufacture of object-glasses of sufficient aperture to compete with the light-grasping power of large reflectors, used to be the want of homogeneous flint-glass; the salt of lead which is employed in its manufacture, and which gives it its superior dispersive power, having a tendency from its weight not to mix uniformly with the other ingredients, and if intermingled by mechanical means, to form streaks and veins very prejudicial to neat definition. Small discs might easily be procured, but with increasing size all kinds of imperfections increased with fatal rapidity, so that, as recently as 1820, lenses of five or six inches were scarcely procurable. In order to obviate this serious evil a remarkable modification was devised in the year 1828, by Sir

John Herschel's tutor, Mr. Rogers.* In this construction the object-glass is a single plate lens, and the correction of the two aberrations is produced by a combination of a plate and a flint lens interposed in the cone of rays before they reach the focus. To comprehend the method of doing this, we must consider what would be the effect of placing together two lenses, one convex and one concave, of equal focal lengths. Then, if each were of the same kind of glass, or of glass having the same amount of dispersive action, the rays would pass through quite colourless; but if their dispersive powers were unequal, though the general mass of rays would still be transmitted parallel, yet colour would be produced in proportion to the inequality of the dispersions, and in the direction of the stronger of them. In the case, therefore, of a plate convex and flint concave of equal foci, there would be colour due to the superior dispersion of the flint, and acting in a concave direction, or opposite to that of the object-lens. Now, supposing this uncorrected colour to be equal in amount to that of the object-lens, it is plain that if the two lenses producing it were placed immediately behind the object-lens, they would destroy its chromatic aberration, and we should have a combination similar to Dollond's triple object-glass already described (INTELLECTUAL OBSERVER, vi. 451). This, of course, would require the flint disc to be of the full size. If, however, we could increase the amount of the dispersion produced by the two combined lenses, we might remove them from the object-lens towards its focus, to a point where its convex or positive dispersion, increasing as it departs from its source, would be exactly balanced by their negative excess of colour, and since the cone of rays would there be smaller, we should gain in respect of the size of the flint lens exactly in proportion as we could remove it from the object-lens. But as the excess of concave dispersion in the two combined lenses, which we may collectively term the *corrector*, depends entirely upon their focal length, we have only to shorten their foci, in order to increase the excess of dispersion to any required amount; and thus *in theory* an object-lens of plate glass, however large, may have its colour corrected by a disc of flint glass, however small. In practice, however, a limit would soon be reached, as the deepened curves required to produce the shortened foci would introduce too much spherical aberration to be even approximately corrected; for it is only with very small segments of a sphere, as

* A similar idea had, it seems, occurred several years before to Sir David Brewster, who had described and constructed lenses of this kind, and perceived their applicability to telescopes; but he admits that the invention was original on the part of Mr. Rogers. The late Dr. Dick stated that a four-inch achromatic was actually constructed on this principle with success by Mr. Wilson, of Glasgow, before he was aware that Mr. Rogers had proposed a similar plan.

we have already observed, that this kind of compensation can be rendered perfect; and hence a moderate ratio between the apertures of the object-lens and corrector is preferable; if we assumed one-half, which would give very practicable curves, we could still employ a flint disc of only four inches (or a little more, in order not merely to take in one point, but some extent of field) to correct an object-lens of eight inches aperture.

This construction, as compared with the ordinary double achromatic, is attended with several advantages and disadvantages. The latter are obvious: the loss of light, perhaps 12 per cent., from two extra reflections and one transmission, and the greater chances of error in centring and working two additional surfaces; and, besides these, which are common to it with the triple achromatic, there is less possibility of correcting pencils oblique to the axis, and much difficulty in preventing the corrector from getting out of that perfect adjustment with the object-lens which is absolutely necessary. Flexure, too, in the tube would, from the position of the corrector, be more prejudicial; and this has been found an annoyance even in the ordinary achromatic when the tube is of great dimensions; it was noticed by Airy in the magnificent telescope of Poulkowa, and no wonder, since in an experiment by the German optician, Reichenbach, a 24-pounder gun was found to exhibit very sensible flexure when suspended by its centre. But to these defects are opposed great and peculiar advantages; not merely the diminished size of the flint disc, which, in the present totally changed state of the manufacture, is of much less importance, but an experimental mode of final correction, which the constructors of the ordinary achromatic would often be happy to have in their power. For while it is difficult in the usual form to ascertain the precise ratio of dispersion in the plate and flint, and a slight mistake may require the reworking of one of the lenses, in the dialytic construction it is only necessary to obtain a near approximation as to dispersion, the final correction being, as will be readily seen, more easily and accurately accomplished by varying the distance of the corrector from the object-lens, till the most perfect achromaticity is obtained; while, as regards the spherical aberration, this, when such curves have been given to the correcting lenses as may be expected to neutralize it, may in like manner be finally destroyed experimentally by separating the lenses to a short distance from each other. Such at least was the opinion of the inventor, Rogers. The possibility of this latter ultimate adjustment has, indeed, been questioned on mathematical grounds, by an eminent writer on these subjects, Santini of Padua; but Rogers's conclusion was

not only founded upon a self-evident principle, but (unknown of course to Santini) was actually found to answer perfectly in practice. In addition to these conveniences it possesses another of considerable importance. We have supposed the corrector to exert merely a concave dispersion, without general refractive power; but this is by no means necessary. Its curves may be so proportioned as to give it a concave refraction also; the result of which will be the enlargement of the focal image, or, which is the same thing in practice, the shortening of the instrument materially, with the same aperture and magnifying power.

Possessing advantages so much more considerable, on the whole, than its defects, it seems remarkable that this construction should have attracted so little notice. It was carried into effect by Dollond, for Rogers, on a scale of five inches, with success; but I have not heard of another instance of its being even attempted in this country till of late years one was worked by an excellent optician, Wray, for Mr. Buckingham, the constructor of the magnificent achromatic of 20 inches aperture, and about 30 feet focus, which made so conspicuous an appearance in the nave of the International Exhibition. It had $8\frac{1}{4}$ inches of clear aperture, and its possessor has spoken very highly of its defining quality. But with these exceptions, it seems to have been ignored in England. On the Continent, however, its advantages were more fully appreciated. At the recommendation of the celebrated German mathematician, Von Littrow, it was taken up towards 1833* by an optician of Vienna, named Plössl, by whom a great number have been constructed, and some of considerable magnitude. About the year 1850 one was completed of 6·4 inches for Jassy, another for Biczke of 8·5 inches, and another for Athens of 8 inches. The latter has now been for some years under the charge of the celebrated Dr. Schmidt, who does not, however, speak very favourably of its present condition. One of 6·4 inches was also ordered for the magnificent establishment at Poulkowa. The Baron Dembowski, well known as a very industrious and careful measurer of double stars, employed one for a long time at Naples of $5\frac{1}{3}$ inches aperture, and 5 feet 4 inches focus, which would perfectly separate ζ Boötis, and elongate γ^2 Andromedæ. His subsequent adoption of an ordinary Merz achromatic of larger size (see INTELLECTUAL OBSERVER, vi. 59), may however be taken as a tacit preference of the other construction. But the *chef-d'œuvre* of Plössl appears to have been an instrument made for the Sultan about 1851, which had an aperture of fully 11 inches, and focal length of

* Herschel's date is 1839, when perhaps it became generally known, but that in the text is from a contemporary publication by Gruithuisen.

11 feet 9 inches, and with a power of 610 would divide γ Coronæ Borealis, $0''{\cdot}6$, 4 and 7 magnitude. This seems to justify Von Littrow's opinion, that it might set itself boldly in competition with the productions of the best workshops in Europe. It would be interesting to know what may have been the subsequent fate of this noble, but, as may be apprehended, most unfortunately destined instrument. The neglect with which the construction has been treated in England seems matter of regret. It is true that some of our first opticians look unfavourably upon it, but it has never had the advantage of a trial at their hands. Many of Plössl's smaller instruments bore a very high character. Prof. Schumacher had one of $25\frac{1}{3}$ Paris lines aperture, with powers 60 and 86, which would separate ϵ Boötis, and which was thought by Struve I. and himself superior to anything they had seen of that size. Sir J. Herschel's opinion, too, that it is "a very artificial and beautiful invention, highly deserving further trial," ought surely to lead to a more practical inquiry into its capabilities; and this, our readers will be glad to find, has been undertaken by Mr. H. Ingall, with much prospect of success.*

The dialyte, however, was not the earliest attempt to obviate the difficulty arising from the scarcity of large discs of flint glass. We have given it priority, because its construction with glass alone follows most easily from that of the common achromatic, but it had been anticipated by an ingenious contrivance of Prof. Barlow. This celebrated mathematician had perceived that, as our readers will readily understand from what has been said of the dialyte, a material possessing a stronger dispersion than flint glass might be set back from the object-lens by a distance corresponding with its chromatic power, and such a material he found in sulphuret of carbon. This extraordinary fluid was just suited to his purpose from its perfect transparency, absence of colour, and high dispersive quality; and to form it into a concave lens it was only necessary to enclose it between two discs of glass, each wrought to the requisite curve, but with parallel faces like a watch-glass, so as to have no refractive or dispersive action. These were applied to the two opposite sides of a third disc, which being wrought to corresponding curves exactly coincided with them, but whose centre was bored out so as to convert it into a broad ring. The three discs and the fluid being all gently warmed to a temperature higher than any likely to occur in practice, the ring was placed horizontally upon one of the discs,

* M. Valz, the ex-director of the Observatory at Marseilles, had undertaken the construction of two dialytes, with apertures of about $7\frac{3}{4}$ and $15\frac{3}{4}$ inches; but their execution was frustrated by his retirement (an unwilling one) in 1863.

and the other slipped on one side so as to leave a small portion of the interior of the ring open; through this the fluid was poured in, and the upper disc slipped over it into its place. The subsequent contraction of the fluid in cooling would leave a vacuum-bubble, which was kept out of sight by allowing the ring an extra amount of aperture. Cement with tinfoil or paper being applied round the edges, the lens was rendered complete and permanent; and being placed like the corrector of the dialyte would have a similar effect in all respects, excepting the invariability of the spherical correction. In 1827 Barlow constructed a 6-inch telescope of this kind, and in 1829 one of 7·8 inches, with a satisfactory result. A subsequent attempt with eight inches, undertaken in 1833 for the Royal Society, proved a failure; and such might be considered my own humble imitation in 1830, with four inches. It served me, however, for four years, with tolerable achromaticity, but much uncorrected spherical error. Whether the plan may have been tried by others, I do not know. Several limpid fluids have since been discovered whose properties might merit investigation, especially chloroform, which from its density seems to promise well.

But we have not yet mentioned one very serious drawback, affecting more or less every one of the constructions already described. Not one of them answers to its name. They are not "a-chromatic," *i.e.*, colourless; and no workmanship of man can render them so. However carefully the correction may be adjusted, there is invariably a fringe of colour surrounding every bright object in focus; and a single glance with a high power at the planet Venus will make it visible, or even at the foliage of a dark tree against a white cloud or bright blue sky. This uncorrected fringe, or "outstanding colour," is a serious drawback to the beauty of the telescopic image, and a waste of valuable light. Its cause, technically termed the "irrationality" of the spectra of plate and flint glass, may be easily understood by observing that not only is the *whole amount* of dispersion into colour different in plate and in flint glass, but their action on different parts of the spectrum is not the same—the plate throwing the more luminous central rays of the spectrum nearer to one of its ends, the flint nearer to the other. Hence, it is impossible to neutralize the whole spectrum by lenses of two kinds of glass. If we unite the extremities, the central rays will go on one side, and be "outstanding" in focus; if we correct the colours nearer the centre, the extremities will not balance each other. The great art, therefore, of the optician is to neutralize the most vivid and predominant tints; he can do no more; the rest must take their chance. There is, however, some dis-

cretionary latitude, and a choice of evils, and different makers do not prefer the same mode of correction. Glasses which are technically said to be "over-corrected for colour," are generally thought the best. In these, the dark-blue rays which, from their great refrangibility, naturally fall short of the general focus, are projected beyond it by the concave flint, and consequently form an external fringe to the image, which, from their loss, is slightly tinged with the complimentary reddish-yellow;* but this over-correction may be carried too far, producing a needless excess of blue, as is said to be the case with the Munich object-glasses. Sir John Herschel has said, that the whitest pencil is produced by uniting the brighter red bordering on orange, and the most vivid blue, where it begins to pass into green. Glasses thus corrected show a purple or lilac fringe round a white object within the focus, and a green one without it, and "to go beyond this point," he adds, "with the ordinary materials, seems hopeless." In the various forms that we have described, the defect uniformly exists. It may be somewhat reduced in more than one way: in the triple achromatic (and by parity of reason it might be so in the dialyte) by employing a third kind of glass, called Savoy plate; in the peculiar form of double object-glass, proposed by Gauss, and modified by Steinheil (INTELLECTUAL OBSERVER, iii. 148), by means of a slight separation of the plate and flint lenses: Barlow had hoped to remove it in his construction, but was disappointed; quadruple object-glasses have been produced by Steinheil, of Munich, and Grubb, of Dublin,† in which it is reduced, but with a serious loss of light by reflection, unless the inner surfaces are cemented together, which is considered objectionable by the best opticians. To one man alone has it been given to devise and accomplish the complete removal of this great defect, and he has never yet received that general acknowledgment of his great ingenuity and skill, which was his unquestioned due. Towards the close of the last century, Dr. Robert Blair, Professor of Practical Astronomy in the University of Edinburgh, carefully investigated the subject, and ascertained the existence of transparent and colourless fluids, whose separate action upon the green ray (which may be considered the standard of deviation) were respectively greater, and less, than that of

* This should be carefully borne in mind in examining the colours of stars. Struve I. found that the higher powers of the Dorpat telescope (532 to 848) gave them a yellowish tinge.

† The observatory at Armagh is provided with one of these instruments of seven inches aperture, with the unusually short focal length of sixty-eight inches, which is probably rendered practicable by the double number of curved surfaces, each, therefore, only half as deep as in the ordinary form. (These are Sir J. Herschel's data, but I am informed that the aperture is really eight inches.)

crown glass, and which, therefore, in conjunction, would produce exactly the same effect with it. In some cases he enclosed the separate fluids in distinct cells; in others, where they would not decompose each other, he mixed them in one cell between two convex crown-glass lenses. The object-glasses thus formed were of such exquisite quality as to correction, that no trace whatever of colour remained; and the mathematical skill of the inventor enabled him so to remove the spherical error (for which purpose, however, a separate glass lens seems to have been requisite with large apertures) that he actually constructed, in 1791, an object-glass of excellent definition, with only about nine inches of focus to *three inches of aperture!* while, with less exaggerated proportions, there was no comparison between the performance of his telescopes under very high powers, and that of the best ordinary achromatics.* Little notice, however, was taken of this beautiful discovery. Dr. Blair's attention was subsequently directed to a still more important object, in which he was equally successful—the preservation, during long voyages, of lime-juice, on which the health of our seamen materially depends; he instructed, however, his son in his processes, and that gentleman publicly announced, in 1827, his intention to commence the regular manufacture of these instruments, if sufficient encouragement could be obtained. To the sole objection which could be raised—namely, on the score of want of permanency—Mr. Blair was able to give a full reply, the object-glasses having remained unchanged for twenty-one years; but I regret to add, that I have never heard of a single telescope being constructed in consequence of this announcement. Let us hope, that since those days we have made some advance in scientific zeal, and, with the wish that something may yet be done to give due effect to this admirable discovery, we will close our lengthened examination of the construction of the Achromatic Telescope.

NEBULA.

28.—In the *Philosophical Transactions* for 1789, Herschel I. describes a star 9 mag. *f δ Geminorum,* 9m. 6s. of R.A., 1° 1′

* It is curious how narrowly this discovery escaped Newton. He says, in one place, that "it did not seem to him impossible for contrary refractions so to correct each other's inequalities, as to make their difference regular; that, for this purpose, he examined what may be done, not only by glasses alone, but more especially by a *complication of divers successive mediums,* as by two or more glasses, or crystals, with water, or some other fluid between them, all which together may perform the office of the object-glass, on whose construction the perfection of the instrument chiefly depends; and that the result of these trials, as well as the results of theory, would probably be given on some future occasion." Yet we find him, after all, acquiescing in the hopelessness of any such improvement upon the old refractor.

more S., as having "a pretty bright milky nebulosity equally dispersed all round it," which he calls "a very remarkable phœnomenon." He numbers it 45 of his IVth Class, *i.e.*, that of *Planetary Nebulæ*. In the earlier catalogue of Herschel II. (1833), where it stands No. 450 (it is 1532 of the General Catalogue), it is termed "a star 8m. exactly in centre of an exactly round bright atmosphere 25″ diam. The star is quite stellar, not a mere nucleus. Another star 8m. distant 100″, and about 85° *n p*, has no such atmosphere. A most remarkable object." The Earl of Rosse calls it "most astonishing," and represents it as a star surrounded at some little distance, rather nearer perhaps on the *np* side, with a bright nebulous ring, within which again is a less luminous area, brightening up as it approaches the star near its centre; leaving, however, a small dark space close to the star on the *f* side. This curious object does not require a large instrument to bring out all its interest. I have seen it formerly, on two occasions, with $3\frac{7}{10}$ inches of aperture, as a small telescopic comet. 1864, Dec. 1, on looking for it with $5\frac{1}{2}$ inches I caught it with about 30, and saw the central star with 65. The haze, I found, bore magnifying well (whence H probably gave it its planetary rank); it appeared slightly more extended *s* a little *f*, and with 451 there seemed to be a very feeble trace of a narrow border of greater brightness at the edge in that one direction, something like a cometary envelope. At this time I had so indistinct an idea of what Lord Rosse had seen, that my observation may be fairly considered an independent one.* The most striking thing, however, that I noticed, was the angle of position with the neighbouring $7\frac{1}{2}$ mag. star. This was given by Sm., 1836·22, = 355°, identical with H's angle, 1833, denominated by the quadrant, as was his practice at that time. I had no micrometer or cross wires in the field, but a simultaneous view of *Polaris* with the left eye, and in four eyepieces, gave the line joining the stars an inclination below the pole of about 5°, consequently bringing it out of the *n p* into the *n f* quadrant.

With very little reason, generally speaking, to trust to my own estimates, all the circumstances of this case induced me to feel unusual confidence in my result; and I was much more gratified than surprised when Mr. Knott obliged me with a very full and careful set of measures with his $7\frac{1}{3}$ inch object-glass, the mean of which gave for 1864·97, 100″·2.

* I have since found that Lassell also has figured it much in the same way, but making the bright annulus very feeble on the *p* side, reducing the interior darker area to a narrow ring, and omitting the dark spot close to the star. He says, "The dark circle is very striking, and altogether the object is very beautiful and interesting."

2°·44. It seems then to follow that either the nebula (together with its stellar centre), or its companion star, must have moved very sensibly during the last thirty years; and this conclusion is confirmed by Mr. Knott's reduction of Argelander's intermediate places. It is impossible at present to say which of the two has changed its position, but this will be demonstrated by future measures; and there is a very minute star *p*, forming the apex of a triangle with the others, which, as Mr Knott has remarked, would form a good point of reference, if it has sufficient brightness for measurement. Since Mr. Huggins's wonderful discovery, we are more prepared to accept the alternative of motion in either; and the nebulosity, if it possesses light enough, will be a most interesting object for the spectroscope. If it were not waste of time to reconcile so rough a guess as mine with the results of admirable micrometric measurement, it might be observed that they would be very closely approximated by allowing for the extra-polar position of *Polaris*, and for a remarkable bias in vision with which I have since become acquainted through the writings of Sir J. Herschel. That eminent philosopher, in discussing some ancient and valuable observations of *Castor* by Bradley and Pound, in which the telescopic position of the components was found to be parallel to the lines joining certain other stars as seen with the naked eye, found that angles thus estimated required a correction for a tendency in the two eyes, when comparing two straight lines, or two parts of the same straight line, *beheld by each separately*, to give them a different position with regard to the vertical. The difference amounted in his own experience to 2° 43′, at which angle lines really parallel would seem to converge upwards, if so viewed, that while both lines are looked at simultaneously, each eye sees only the one opposite to itself. The experiment is easily tried with any kind of thin screen edgeways in front of the face, but requires a little care in manipulation; for if the eye is very unequally distant from the opposite extremities of the parallel lines, the deviation will be reversed; nor have I been able to bend a horizontal line in the middle, as described by Herschel, till it is placed in an oblique position. The following simple mode of conducting the experiment, I have found effectual. Take a large thin book, the thinner the better, provided it can support itself without being opened, and set it on end upon a table. On each side of it, pretty close to it, but not touching, lay a sheet of white paper on the table, with a weight on it, so that it may not easily be displaced; then rest the nose on the top of the book, when, of course, only one sheet will be visible to either eye. While using both eyes arrange the sheets carefully, so that their nearest edges shall be as sensibly parallel

as may be; remove the book, without disturbing them, and they will be found very perceptibly convergent; replace the book, and the nose upon it, and they will appear parallel as before. This peculiarity, which Herschel tells us was observed by Bessel also, may perhaps give us a hint for the improvement of stereoscopic vision. It seems probable that if the two pictures were so arranged that their sides were not precisely parallel, their coincidence would be more ready, and the illusion in proportion more complete.

I have since observed (having had my attention drawn to it by some of my correspondents) that with low powers there seems to be a minute nebulous star or speck nearly *s* of the nucleus, about 15″ or 20″ distant, which high magnifiers show as a patch of light; a denser portion apparently of the external ring, between which and the nucleus the haze is less luminous. Mr. Knott has remarked that Sm. has measured from the nebulous star, as if it had been the brighter of the two, which it certainly is not at present.

To find this pair (for as such they are treated in the Bedford Catalogue) we must first get δ *Geminorum*, which is the first conspicuous star in a line from *Pollux* towards the Great Nebula in *Orion*. If we then know, as we ought to do, the dimensions of the field of the finder, there will be little difficulty in turning it to a point 1° S. and rather more than 2° E. of the star, when the nebula will be in the field of a low power. Its place for 1860·0 is R.A. 7 h. 20m. 54·4s.—D.N. 21° 11′ 26·8″.

(Addendum.) Since describing in our last number, the Planetary Nebula 39 ♅ IV., I have found that Lord Rosse's 6-foot speculum shows it as an annulus with a wisp projecting into the interior, and faint fringes all round its edge. He figures the two minute stars, but takes no notice of the larger one belonging to the cluster 46 M., which I still see as I saw it last year, and which appears to have been seen by H. at the Cape.

DOUBLE STARS.

Before the season passes we may add two more pairs to our list.

133. δ *Geminorum*. 7″·2. 196°·8. 3½ and 9. Pale white and purple. Stationary, according to Sm., 1838·92. Secchi, however, thinks the angle increases, having been 184°·15 in 1781, and found by him 200°, 1856·107. Both with my former and present telescope I have thought the large star pale yellow. The companion also has appeared to me, with both, very small for 9 mag.—smaller than the attendant of

Castor, rated 11 mag. by Sm. Secchi, likewise, makes the former 8, the latter 7 mag.—equal to about $8\frac{1}{2}$ and $7\frac{1}{2}$ of Sm. The mode of finding δ has just been given.

134. 38 *Geminorum.* 5″·8. 170°·7. $5\frac{1}{2}$ and 8. Light yellow and purple (1839·17). This pair Sm. considered as probably in motion, with a very slow period, which may be upwards of 2000 years. Its binary character has been confirmed by Secchi, who gives, for 1856·112, 6″·137 and 169°·18, to be compared with Σ's 5″·736 and 174°·88, 1829·24, and ♅'s 179°·9 in 1783. This beautiful object is pointed at by a line drawn from *Procyon* through its *np comes* β *Can. Min.*, but it must be bent towards the S.; or it may be found by a line from *Pollux* to *Bellatrix* (γ *Orionis*), which points out γ *Geminorum* (3 mag.) in mid-distance; a little *f*, but more *s*, from this star we find a wide pair, ξ^1, 5 mag., and ξ^2, 4 mag., about 2° *f* from which lies 38.

OCCULTATIONS.

April 5. ω Leonis, 6 mag., 11h. 53m. to 12h. 43m. (For a notice of this remarkable star, see INTELLECTUAL OBSERVER, iv. 352. The present will not be an unfavourable opportunity for the observation.)—6th. 16 Sextantis, 6 mag., 8h. 7m. to 8h. 14m. —12th. 3 occultations: 5 Libræ, 6 mag., 7h. 50m. to 8h. 51m.; 8 Libræ, 6 mag., 10h. 40m. to 11h. 52m.; α^2 Libræ, $2\frac{1}{2}$ mag., 10h. 51m. to 11h. 59m.—28th. 120 Tauri, 6 mag., 7h. 59m. to 8h. 53m.—30th. 68 Geminorum, $5\frac{1}{2}$ mag., 11h. 48m. to 12h. 6m.

NCOGONS.

ON THE DEVELOPMENT OF THE PYCNOGONS.

BY GEORGE HODGE.

(*With a Tinted Plate.*)

In a former part of the Intellectual Observer,* the leading characters of the Pycnogonoidea were briefly glanced at, in such a manner as to serve as an introduction to the study of these animals.

Observations extending over several years, with admirable opportunities of obtaining a plentiful supply of specimens, have enabled the writer to gather somewhat into form certain vague and conflicting notions regarding them—more particularly with reference to their development.

Few observers have made the development of these animals their study; and in most cases, if not in all, investigation has been directed to the earliest stages of the larvæ, owing in a great measure to the extreme difficulty experienced in pursuing the subject further—all attempts to rear the larval forms having failed.

Developmental studies of the lower forms of life are mostly fitful and uncertain—a fact here, another there, gradually builds up the framework we desire, and enables us to link the whole together. Frequently we may have to wait a year, or even longer, to confirm a single observation, and when this delay is experienced in cases where abundance of material can be obtained, it will readily be conceded, that in the case of rare animals, the progress cannot fail to be slow. This is especially the case with the Pycnogons, for with the exception of the littoral species, few of our marine animals are more difficult to procure. They can only be obtained in a suitable state for developmental studies, by the expenditure of much time, and with considerable personal discomfort. The dredge must be kept going on every possible occasion, to afford a supply of living specimens—and it is the dredger alone who knows the discomfort and uncertainty of this pursuit.

The generative function in the Pycnogonoidea still continues a profound mystery, with every likelihood of remaining so. It is one of those secrets which defy solution. Not a trace of an internal ovary has been detected; neither is there any difference in the form of the male, as compared with the female—so far as has been made out to the present time—further than the well-known "false feet" or "egg-carriers," which in certain genera are only possessed by the so-called

* July, 1863, Part xviii.

females, whilst in others (according to Kröyer) both males and females possess them.

These false feet, or egg-carriers (for no other office has been assigned to them), are jointed limbs, produced from the anterior portion of the thorax, between the origin of the rostrum and the first pair of legs; the number of joints of which they are composed varies in different genera, and affords a generic character in the case of *Pallene* and *Phoxichilidium*: the former having nine or ten joints, and the latter only five. The *ova*, which are found in masses of a globular form, to the number of two or three, are attached to these limbs; the limb usually passing through the centre of the globular mass. At the earliest stage at which the ova has been examined, they are merely little granular bodies, each the $\frac{1}{500}$th of an inch in diameter, or thereabouts, according to the relative size of the species producing them.

The "oviferous mass" is composed of a large number of these ova, and invested by a tough skin, which nevertheless admits of extension during the enlargement of the granules. It seems highly probable that the earliest stage of this mass is a single germ, which undergoes segmentation, and resolves itself into a number of independent ova. This view is suggested by the fact that in early stages the oviferous mass is a hard ball, consisting of a number of closely compressed ova, which by degrees assume a globular form, and then separate from each other; and further than this, each ovum is attached by two or more filaments to the skin, which invests the whole, proving that it has a close and intimate connection therewith. But how this oviferous mass becomes attached to the false feet or "egg-carriers," no one has been able to discover, nor even surmise. The development of these animals in their earliest stage is consequently involved in obscurity.

Various observers have recorded the result of their observations respecting the earliest stage of several species. Kröyer has, however, done more than any one else, for he figures several stages;* whereas other writers have merely recorded their observations on the stage immediately after quitting the egg.

I have only been fortunate enough to trace out the entire development of two species (*Phoxichilidium coccineum* and a species of Nymphon); but they present such totally different results that neither can be taken as a type of the development of the order, and it seems highly probable that each genus will be found to vary considerably from those associated with it.

* Sur les Metamorphoses des Pycnogonoides. Par M. Kröyer. *Ann. des Sciences Naturelles*, 1842. M. Kroyer in *Gaimard's Voyages en Scandinavia.*

The writer has already published his observations on the development of *Phoxichilidium coccineum.** It may not, however, be altogether supererogatory to briefly reproduce some of the circumstances attending the singular metamorphoses of this animal, as it is principally the object of the present paper to present a *resumé* of the state of our knowledge respecting the development of these animals.

This species is common on our rocks at extreme low water, and is doubtless familiar to most persons conversant with our littoral fauna. During the winter and early spring months the females are found with large oviferous masses attached to their false feet, which in course of time produce curiously formed larvæ (see Fig. 4). They are of a rounded form, and possess two pairs of legs, a pair of foot-jaws, and a rostrum; they retain this form for a few days, and are usually attached to the oviferous mass by four long filaments, *which proceed from the tips of the legs*. The connection does not, however, last long, for the little beings soon enter upon a free and independent existence, during which they must moult, for on again meeting with them, they present a very different aspect. Now comes the singular portion of their life history, which to understand requires us to be somewhat acquainted with a totally different animal.

During the spring and early summer months the rocks begin to furnish their annual growth of Algæ and Zoophytes. Conspicuous amongst the latter, on the Durham coast, is a very elegant little Hydroid Zoophyte, *Coryne eximia*, which, for the information of those not conversant with this order of animals, may be described as a tiny shrub of a horny nature, bearing club-shaped polypes at the termination of each branch. These polypes are produced by the gradual accumulation and growth of the fleshy and chitinous substances of the polypary. At first a mere short rounded stem, the terminal part being less dense than the stem, an accumulation of organized material takes place, which in due course developes into a polype. Whilst examining some stems of this Zoophyte I noticed that there were a number of sacs attached to the stems, which, although a part of the polypary, were nevertheless different to any growth or part of the animal. On being opened, these sacs were each found to contain a curious little animal of a bright red colour. The subject was followed up, and it was shortly afterwards proved that the animal in question was a stage in the development of *Phoxichilidium coccineum*, in advance of the larval forms observed immediately after escaping from the egg. Other stages were found (still within the Coryne), showing further advancement, until

* *Annals and Magazine of Natural History.* January, 1862.

finally the egg was traced to the mature animal, disclosing a very singular and unexpected mode of development; for the question at once arises, How do the larvæ gain access to the Zoophyte?

The development of *Pallene*, a genus which in some respects resembles *Phoxichilidium*, varies from that described in certain important respects. The writer has only had an opportunity of examining one of the larval stages in a specimen of *Pallene brevirostris*, the observations being unfortunately brought to a somewhat hasty termination—the specimen being accidentally destroyed. It was, however, observed that the young in a far advanced stage were attached to the false feet of the female, in what manner could not be made out, owing to minute size, and being very much crowded. They possessed foot-jaws, a rostrum, and three pairs of legs, *all of similar form to those of the adult animal;* proving that the young remain attached to the parent up to a late period of their development, and perfect the growth of their limbs—or most of them—whilst so attached, in such a manner as leads one to suspect the development of the genus must be upon a plan altogether distinct from others examined.

In *Nymphon* the development takes a much simpler and more easily understood plan. Several species have been examined in their earliest or larval stage, at which time the young animal is about the $\frac{1}{100}$th of an inch in length, and scarcely so broad. It possesses two pairs of feet, which are three jointed, the last joint being elongated and in the form of a claw; a rostrum and a pair of foot-jaws of large size, which are quite out of proportion to the remainder of the animal: the nippers are strong, the moveable finger usually overlapping the other.

A stout spine-like appendage is produced from the summit of the first joint of each foot-jaw; from the outside proceeds a long slender filament, by which the larva is attached to the oviferous mass for a short period after its birth: being of an active habit, it soon frees itself, and is then carried about by the motion of the water until it finds a lodgment amongst the stems of Zoophytes or the like, where it receives food and shelter. Doubtless, large numbers are carried about by the currents of the sea and perish, for although all of the Pycnogons are decidedly prolific, and each individual carrying ova, must produce many hundred larvæ in a season, the mature individuals are unquestionably rather rare. Mature Nymphons are usually obtained amongst Zoophytes from deep water, but appear to be very rare between tide-marks; it is, therefore, singular that the stage in advance of the larval ova, just described, should only have been found nestling amongst the

stems of *Bugula plumosa,* a littoral Zoophyte on the Durham coast—although various Zoophytes from deep water have been subjected to the most careful scrutiny. Several curious little animals were found on this Zoophyte a few years ago, at a time when the early stages of the Pycnogons were unknown to the writer; they proved a complete puzzle until earlier and later stages were found, when an insight into their probable character was gained, and extended observations on the development of these animals clearly established the early life of Nymphon.

A reference to the plate accompanying this will enable the reader to understand the further changes which take place. It will be observed that the posterior portion of the body is obtusely rounded, this gradually changes, until at last a slight notch appears on each side, which becoming more decided presents the appearance of three narrow lobes. These separate from each other, those on each side gradually elongating and developing into legs; whilst the centre one, increasing in width, pushes out the newly formed limbs in a lateral direction. The joints are then visible, at first close to each other; but by degrees they increase in length, after which the claws on the terminal joint appear. The hairs are also produced, and the little animal presents a most grotesque appearance (see Fig. 2). The posterior portion, meanwhile, continues to elongate, and going through the process just described, a second pair of legs is the result; again it repeats the operation, when a third pair is produced. The young animal now closely resembles a Pycnogon, excepting the presence of the anterior rudimentary limbs and the large spine on each foot-jaw; if it were rid of these, it might readily pass for a young Pycnogon about to produce its fourth and last pair of legs. We accordingly find that these rudimentary limbs, having served the requirements of the larval stage, are now no longer needed, and are readily got rid of by a moult, which takes place at this stage, the fourth pair of legs being usually produced at the same time. Having neither palpi nor false feet it is of course far from perfect, and might be either a *Nymphon,* a *Pallene,* or a *Phoxichilidium,* for what we could tell. These important organs are afterwards produced, the palpi being the first of the two to appear. Near the base of the foot-jaws a wart appears, which gradually elongates and developes into these well-known and characteristic parts. The false feet are produced in a similar manner, from a wart growing near the origin of the first pair of legs, and on the full growth of palpi and false feet the animal attains maturity.*

* See figure in INTELLECTUAL OBSERVER, 1863, p. 416, fig. 2.

The larvæ of Pycnogonum, Achelia and Zetes, resemble the species just described in their general contour, although, as might be expected, there are certain characteristic differences. They all possess foot-jaws similar to those described, from which are produced the filamentary appendages as in Nymphon. These organs in all the species examined are kept constantly in motion—a sort of "whipping action," which it seems probable may assist in impelling the little animal through the water. The presence of foot-jaws in the larvæ of these genera is a very singular circumstance, for the mature animals are quite destitute of them. Excepting, therefore, for the fact of having obtained the mature animal with the larvæ attached, one might reasonably be disposed to question the possibility of the immature animal being in apparent advance of its parent in certain respects, for foot-jaws are undoubtedly a type of elevation.

Much has yet to be learnt respecting the development of these animals, and so far as one can judge from analogy, all must undergo some singular metamorphosis between the two stages known, the earliest and the mature. Those observers who have opportunities of obtaining living specimens would do well to endeavour to make out the development of *Pycnogonum littorale*, as it seems highly probable it will prove quite distinct from those just described. Hitherto it has eluded the writer, possibly some one else might be more fortunate.

EXPLANATION OF THE FIGURES.

Fig. 1. Larva of *Nymphon*, as attached to parent (magnified). 2. Second stage of the same animal, ditto. 3. Third stage of the same, ditto. 4. Larva of *Phoxichilidium coccineum* as attached to parent (magnified). 5. Embryo of *Pycnogonum littorale*, ditto. 6. Larva of *Pycnogonum littorale*, ditto. (All represent the under surface, to show origin of rudimentary limbs.)

NOTE ON AN ARTICLE ENTITLED "LIFE CONDITIONS IN OTHER WORLDS."

CONTAINED IN THE "INTELLECTUAL OBSERVER" FOR MARCH, 1865.

BY GEORGE E. ROBERTS, F.G.S., HON. SEC. A.S.L.

WE are familiar with many subjects said to be, in the common parlance of the day, of "world-wide import," but it so rarely happens that an inquiry is introduced in a liberal philosophical spirit, which soars beyond our mundane economy, that it appears to me highly desirable that the subject upon which I offer a "Note," one illustrated by so many cautiously-chosen facts and excellent suggestions, should not at once be lost sight of amid the crowd of natural history papers which enrich the INTELLECTUAL OBSERVER. We have been so much accustomed to limit the cause, or the extension, or the working of a natural law to the earth and its surrounding atmosphere, when reasoning upon geological or biological subjects, that many of our theories, derived from such a limited reading of the book of nature, have had to be abandoned, and others modified as the area traversed by our intellectual perception became more extended. And now that it may reasonably be surmised that no element in the physical construction of the earth, or law which governs it, is confined either in existence or operation to our globe, it becomes more than ever certain that many of our conclusions and deductions will have to be re-examined under the light of a broader philosophy, and more than ever imperative that the utmost caution should be exercised in propounding any theory. If, as it appears most probable, this world and all it containeth of animate life is to be expressed merely in mathematical formulæ, as a term of a connected series, which, varying in value each from the other, together make up the perfected scheme, it will assuredly lead to a more large-minded method of studying the higher and more complex branches of natural research, and give a better moral tone to the work.

Studies in comparative natural philosophy, as *e. g.* between the earth's atmosphere, chemically or otherwise, and that of Mars or Jupiter, will be more extensively made; and who can say how many remarkable relationships with, or divergences from, the standard we have until lately set up from examination of the earth alone, as one common to the universe, may not be discovered? And although we may never by any means of research make out with certainty the actual existence of life on any one of the planets, yet after discovering the conditions which they may possess favourable for its existence, we shall

be less puzzled in our endeavour, hitherto so fruitless, to make up the palæontological and zoological record of life, extinct and existant, upon the earth's surface; and hemitypic birds, reptilian fish, creatures retaining through life rudimentary limbs or organs, or embryonal characters, may appear as significant of orders of life existant in other worlds, perhaps in a more typical or perfected form. We shall not be the less wise if we are thus compelled to study the fauna and flora of the earth as a fragment of a scheme of life, in which, may-be, much is but shadowed to us, and some elements concealed altogether. If increase of such knowledge as the author of the paper suggests will lessen our dependence on schemes drawn from objects ocularly or tangible before us, it will surely aid our faith in the wisdom and beneficence of the Creator.

AIDS TO MICROSCOPIC INQUIRY.—No. V.

Simple Forms of Life.

We do not propose to publish this series of papers in the order in which they would be most logically arranged, as a less regular method will afford more variety, and enable us more quickly to meet the wishes of subscribers requiring different kinds of information. We shall, therefore, postpone the further consideration of certain points of physical science essential to microscopists, and devote our present attention to Simple Forms of Life. We will suppose a collection of ordinary objects obtained from a pond or clean ditch, by bringing home weeds as well as water, and that the student has thus before him specimens of animals and vegetables the characters of which will be more or less definite and distinct. The first question a young microscopist puts is, "How am I to know animalcules from plants?" and, although the query may appear easy of solution, the establishment of fixed lines of demarcation not only remains a permanent difficulty, but at last a modification of the old notion of zoophytes, or animal-plants, is actually revived, although, by no means including the objects for which the designation was originally employed, nor suggesting the precise ideas which the older naturalists entertained. If we were to say that the simplest form of life consists of a single *cell*, we must so far modify that term as to make it comprehend a globule or molecule, in which there is no special distinction of *cell wall* and *cell contents*. Properly

speaking, a *cell* is a chamber of some sort enclosed on all sides, and physiologists employed it to designate a little chamber, or space, enclosed by a membrane or tissue, and holding inside it living matter. It is not necessary that we should explain the details of cellular physiology as it was laid down a few years since, as scientific men have pretty well agreed that it must be greatly modified, and it is impossible to avoid recognizing the fact that the functions of life may be performed by little globules or molecules of appropriate matter, which are not surrounded by any distinct membrane or wall. It is, however, probable that the smallest living object consists of matter in at least two states, and if from no other cause than the influence of position, the outside layer will differ more or less from the inner portions.* It might appear difficult to conceive of a simpler animal than an amœba, but a high power shows that the gelatinous material, or sarcode, of which it is composed contains a number of spherical molecules or granules, and any one of them, if isolated and capable of sustaining its life, might, perhaps, represent what, if we adopt the cellular nomenclature, might be called a unicellular creature.

The amœba, in its simplest state, is an illustration of life, with predatory habits and considerable activity, carried on without the help of positive organs. Former numbers of the Intellectual Observer have described the villous projection, discovered by Dr. Wallich, in certain forms of this creature, and it also possesses an apparatus for reproduction, as he has shown. We may, however, regard all its ordinary proceedings as carried on without the aid of distinct organs, although the various globules it contains, and which present no distinctive character to the eye, may still have separate functions to perform. Young microscopists are pretty sure to pass over small delicate amœbæ without notice, and it is a mere chance whether they happen to turn upon large easily-noticeable forms. If they have any more experienced friends to help them, they should see an object of this kind as early as they can, as some conception of its appearance and ways is very desirable at the commencement of a study of organic beings. We see a mass of jelly moving by the faculty of thrusting out portions of its substance into projections termed *pseudopodia*, or false feet. Out goes, or rather *flows*, a dribble of the jelly, extending into prolongations longer and thinner, or thicker and broader, according to the particular specimen under notice. The outside layer (which may soon become the

* See a former article, Vol. vi. p. 75. The last sentence, page 79, is especially applicable.

inside) gets on first, and sticks to the glass slide on which we view it, then comes the rest of the creature, globules and granules, flowing and rolling over each other, until the point of vantage gained by the false foot is reached by the mass. Now another false foot is thrown out, and the same plan repeated. If a suitable morsel of food comes in its way—and it seems very fond of coloured monads, which often give it the appearance of having dined on glittering gems—it opens a cavity, sucks the article in, and the hole closes up, leaving no trace that any solution of continuity has occurred. Though it has neither mouth nor stomach, it exhibits full animal characteristics. It lives upon organic matter already prepared, while a typical plant absorbs inorganic matter and organizes it for itself. Though it has no nerves, it must have some sort of sensitiveness, as it knows when to open a cavity in its flesh and what to swallow in, and we also notice a capacity of adapting itself to the circumstances it meets in its somewhat slow and limited journeys; thus, if it encounters an obstacle, it does not persist in trying to force through it, though it will squeeze through a narrow gap, nor does it merely bound back in a mechanical way. It appears therefore to have volition of a humble sort. Here then we see that a few molecules of a *protein* substance* connected together under that species of partnership and co-operation which is implied by the term *life*, are able to do most of the acts essential to the mere existence of higher kinds of animals.

We shall not now anticipate remarks that will come appropriately in subsequent papers, but we may observe that matter in the condition of the flesh or sarcode of the amœba not only reappears in other groups of animals, some of which, like the *Foraminifera* and *Polycystina*, form exquisite shells of lime or flint, while others build up the fabric of sponges, the harder portions of which act as supports for the soft lining material; but we find something like it in the highest kinds of being, and, paradoxical as it may appear, there is reason to suppose that if we ourselves did not lead the lives of amœbæ, we should not be able to lead the lives of men. Dr. Bowerbank has the merit of pointing out the persistence of the sarcode system throughout the animal world. He says, "As we descend in the organic scale of life, we find the great systems of animal functions, the osseous, the muscular, the nervous, the sanguineous, all becoming simplified, until at last one or more of them is found entirely wanting. But the sarcodous digestive system appears never to be absent, we find it, from the highest organized mammals, in the form of the

* A substance chemically resembling that which composes the tissues of higher animals.

mucous lining of the alimentary organs, passing through animals of every degree of development, until the animal itself becomes simplified to the degree of appearing as a mass of gelatinous sarcode only, or with possibly a central nucleus of membrane, as in *Actinophrys sol*," etc.

The animalcules which the beginner will find in his collections are all composed of sarcode, and the differences to be observed amongst them concern first the degree to which a distinct integument exists, and secondly the character of the organs or parts that can be seen in all but the most elementary and minute kinds.

We shall have occasion to recur again to the animal series, but it will be convenient to take a preliminary glance at some simpler vegetable forms, and although the beginner in collecting objects for the microscope is very likely to pass over the amœbæ he may acquire, he is sure to see plenty of quite a different object, the euglena, a lively little green fish-like thing that abounds in the green scum of ponds. When he sees this creature swim rapidly hither and thither, lashing about the filament which springs from its head and constitutes its organ of locomotion, when he further beholds it change its shape, now taper and spindle, now squat and pear-like, now round, and so forth, who can doubt that a veritable animal is in view? Not so; the euglena is merely a plant, and further inquiry will show that it is not uncommon for simple plants, or for their spores, to possess cilia, and exhibit what is easily taken for voluntary motion.

The possession of a cilium, of which a vibratile filament may be taken as a modification, gives no clue to the animality or vegetality of the object employing it. A cilium may be an organ of voluntary or involuntary motion. We find it continually moving, through mere physical stimulus, in creatures of both high and low organization, or, as in the tentacles of a rotifer like Stephanoceros, evidently under the command of a will directed by a noticeable amount of intelligence.

When a swarm of euglenæ and other infusoria move quickly through the field of the microscope, we have a (relatively) powerful lashing of whips and twirling of cilia, without a single muscle to do the work. Thus the contemplation of a few simple microscopic forms has introduced us to locomotion without limbs (as in the amœba), sensation (of some kind) without nerves, ingestion of food without a mouth, digestion without a stomach, and active exertion, with motion of appendages, without a muscle to do the work. It is like the German story, in which the blind man shoots a hare, a lame one runs after it, and a naked one puts it in his pocket.*

* Kinder und Hausmärchen "Knoist un sine dre Sühne."

It is no part of the intention of these papers to act as a substitute for works of microscopic natural history, to which the reader must be referred when he wishes to discover the name of any particular object, but we shall make some general remarks that may facilitate his search. A simply organized body is likely to be a plant when it contains a substance like chlorophyll, or green sap, or when it is brown, or red, of the tints well known in leaves. Of course the distinction must be made between the chlorophyll matter properly belonging to an organism, and that which may have been swallowed by it. The possession of cilia or whips does not decide animality or vegetality, but moveable styles, hooks, etc., characterize some of the higher animalcules. Red spots looking like eyes are no evidence of animality. The euglenæ possess them, and they can only be distinguished from true red eyes, as may exist in rotifers, by the use of high powers, which shows whether an optical structure really exists.

In studying simple vegetable forms, no object is more accessible than the green slimy stuff that grows on damp stones. A little piece should be scraped off and placed in a drop of water, on a slide, covered with thin glass and gently pressed. It is then ready for view, and is seen to be composed of oval or rounded patches of green matter, enclosed in a gelatinous envelope. The multiplication of these patches takes place by division of the cells. First the cell contents take an hour-glass form, then a constriction appears, finally a division, each half finishing itself off, secreting more of the gelatinous casing, and being ready to split again as before. Sometimes two cells will join and fuse together, with a certain mingling of contents. This is called *conjugation,* and from it a spore results, and that in its turn gives rise to a new individual, which by the mode of fission just described soon produces a fresh generation. In damp weather this plant, the *Palmoglœa macrococcca,* and many other objects more or less resembling it, multiply with great rapidity by the method of division; a little more warmth and dryness promotes the conjugation, and checks the fission. This is somewhat analogous to what takes place with the *aphides,* or plant lice, which multiply by an internal method analogous to vegetable budding, while the circumstances favour their rapid growth, and start a fresh generation by the united action of males and females, when the means of subsistence, and the temperature, are less plentiful and propitious.

A great many simple vegetables exist during a portion of their lives, or in one of their stages, in a motile form, and many little objects taken by early observers for animalcules are plants in this condition. This is the case with the euglenæ,

which may be easily observed in their resting stage. Many plants emit spores that swim freely for a time (zoospores), and others form in little receptacles *antherozoids,* which swim and meet another class of cells, the fertilization of which they effect, somewhat as the pollen, borne on true anthers, acts upon the germs of higher plants.

The entire life history of the lower forms of animals and vegetables is very incompletely known. In a few cases a complete cycle of changes has been traced out, but it is probable that a great number of objects to which specific names are given, are not in themselves complete in their kind, but only early forms of more complicated organisms.

A student is always surprised to find that a great many adult forms have lost faculties or organs that might have been expected to remain. Thus locomotion seems an attribute of dignity, and the loss of the power might be taken as an indication of retrogression; but in many of the lower vegetables, and in many animals also, the locomotive stage is that of infancy, while the adult approaches more to the Buddhist idea of perfection, and enjoys repose. That which should elicit attention is the relation between the structure and attributes of any object, in any stage from that of the egg to maturity, and the observer should watch the work it has to perform for the perpetuation of its own species, and its defence against foes. In both the animal and the vegetable worlds we notice cases in which the infant form must either perish or be able to take care of itself, while in others it may be safely left to depend upon maternal aid. Nature supplies an infinite variety of conditions in which life is possible, and a corresponding variety of living beings capable of thriving under circumstances having the right relation to their structure and ways. As Darwin has shown, those best fitted for their conditions thrive, those least fitted pass away; but such is the harmony of the entire system, that no group can perform its own duties without benefiting others. And in the microscopic world of life we see the interdependence of different sorts of beings displayed conspicuously on a scale which is extremely small if we contemplate only the spectacle afforded in our slides and preparations, but which is enormously large in nature, inasmuch as no process of growth or decay occurs on the surface of the globe without minute organisms contributing towards, or even determining the result.

In the protoplasm of the plant, and in that similar substance the sarcode of the animal, as we can see it through the microscope in the simpler organic forms, we may trace actions that lie at the foundation of all terrestrial life. In the lower kinds a few actions are co-ordinated and combined for a simple

result, in the highest the number of such combined actions is incalculable, the variety great; so if we look to human society, savage existence co-ordinates little and accomplishes little, while civilization grows in proportion as it multiplies the number of actions that conduce to a given end, and exhibits the greatest quantity of individual diversity harmoniously directed to secure the welfare of each in the advantage of all.

NATURALISTS' FIELD CLUBS; THEIR WORK AND WAYS OF DOING IT.

BY GEORGE S. BRADY, M.R.C.S.,
Secretary to the Tyneside Naturalists' Field Club.

Now that naturalists' field clubs have become so numerous and so widely popular, it may be useful to devote a few pages to the consideration of the manner in which they are usually conducted, and the ends which they chiefly aim to promote. Their capacity of usefulness is perhaps greater than at first sight might be imagined; and it will be matter of regret if the opportunities within their grasp are not turned to the best account. Possibly the present widely spread interest in them may prove to be, like other popular hobbies, somewhat evanescent; at all events, it is prudent to act on the maxim, "Make hay while the sun shines."

The first-established of field clubs was the Berwickshire, which began operations in 1831, and owed its formation mainly to the zeal and energy of the late Dr. George Johnston, of Berwick. In 1846 the Tyneside and the Cotteswold clubs were instituted, and since that time a large number of clubs—mostly flourishing associations—have been formed in various parts of the country. The following table exhibits the dates of formation, numbers, and rates of subscription of some of the more important:—

	Date of Formation	Annual Subscription.		Entrance.		Number of Members (1864).
		s.	*d.*	*s.*	*d.*	
Berwickshire Naturalists' Field Club	1831	6	0	...		206
Tyneside " "	1846	5	0	5	0	522
Cotteswold " "	1846	10	0	21	0	94
Warwickshire " "	1854	about 3*s* 6*d*		...		93
Manchester Field Naturalists' Society	1860	10	6	10	6	about 500
Liverpool Naturalists' Field Club .	1860	5	0	...		633
Bristol Naturalists' Society . .	1862	5	0	...		195

It may be noted that the Manchester and Liverpool clubs include amongst their members a large proportion of ladies. There is considerable variety in the modes of procedure adopted by the different societies, but an essential feature of all of them is the holding of "field meetings" in their respective districts during the summer and autumn. In most cases the excursions are made to occupy the entire day; in others, chiefly those where there is a profusion of the fair sex, the afternoon only is usually devoted to the excursion. In these cases, too, the general arrangements seem to be devised very gallantly with reference to the lady constituents, even to the measurement of the stiles on the line of march; for in one of the Liverpool club's circulars for last season I find "the minimum stile guage" stated at *one foot*—a discouraging announcement, one would think. In some cases the practice exists of offering prizes for the best collections of plants obtained during the day's ramble. For my own part, I can see nothing to commend in this system. Indeed, in the case of rare plants existing only on a very limited area, one can scarcely imagine a better device to ensure their speedy destruction. During a recent visit to Manchester, I learnt that such a result had actually been brought about, to some extent, in that neighbourhood.* Moreover, this prize system is not very likely to promote the good of science in any way. The study of nature ought to be, and is, to every real student, its own reward; and such a one will scarcely be found condescending to a competition of this kind.

Very few of the field clubs—indeed, so far as I know, none except the Berwickshire and the Tyneside—attempt the publication of "Transactions" on a more ambitious plan than the simple reporting of their meetings. It is, however, very much to be desired that they should generally make an effort to publish carefully prepared catalogues of the different natural productions of their respective districts. This has, to a limited extent, been accomplished by some clubs, and is one of the most useful directions in which surplus funds can be employed. Local floras, at any rate, might mostly be compiled; but it should be remembered that the value and interest of these

* Since writing the above I find it stated, in the Annual Report of the Manchester Society, that "it is gratifying to the committee to be assured that no rare plant has suffered through the society;" so that there appears to be a diversity of opinion amongst the members of the society on this question. The committee, however, propose to enrich the natural flora and fauna of the district, and so to "add to the beauty and interest of the country round Manchester, by taking with them on their excursions any surplus roots and seeds they may possess, especially of native plants brought from a distance, and also living fresh-water mollusca, and depositing them in places where they would be likely to become permanently established. . . . Also to enrich the neighbourhood by a judicious sowing of the seeds of exotic plants."

publications would be much enhanced by their embracing something more than a mere record of names and localities. The lithological and climatological distribution of plants, and the altitudes which they attain, are matters which should receive attention. And now that a good pocket barometer is so easily attainable, a more useful and agreeable pursuit than the collection of such data can scarcely be recommended to the excursionist, provided that he is already familiar with the plants themselves.

The recording of meteorological observations is a matter quite within the legitimate range of a field club's operations. There are in most districts many observers who keep regular records of rain-fall, temperature, etc.; and if these observations could be got together, and annually tabulated, the result would in time form a record of very great value. As an offshoot of this system, records might also be kept of the periodical return of the seasons, as indicated by the flowering of plants, arrival and departure of birds, etc. Printed forms adapted for these entries have for several years past been distributed amongst its members by the Tyneside Club; and it is not unreasonable to suppose that the habits of observation thus fostered in those who carefully fill up the forms may lead to still more interesting results in other departments.

Those clubs whose district includes any portion of sea-coast would do well to encourage its exploration by means of the dredge. Near the shore this may very easily be accomplished by private means, but when it is desired to explore the more profound depths at a considerable distance from land, the necessary expenses of the work are such as to be beyond the reach of most naturalists. In these cases the pecuniary aid of the clubs may be most useful; and where the work contemplated is beyond even their means to accomplish, it is quite likely that an application to the British Association (provided a competent managing committee could be named) would not be made in vain. During the last three years considerable dredging operations of this kind have been conducted by the Tyneside Club on the north-eastern coast, and they have been largely assisted by grants from the British Association. Altogether a sum of about £130 has been expended; many new forms of life have been discovered, and much interesting information as to the relations of our deep-sea fauna has been brought together; besides which, the training thus given to those who have taken part in the work has been most valuable, and will probably bear fruit for many years to come.

But besides the direct encouragement of natural history and the cognate sciences, a large sphere of usefulness is open to them in endeavouring to discourage the wanton and useless destruction of natural objects, antiquities, etc. Many evils of

this kind are probably beyond their reach or control; others might possibly, by judicious treatment, be partially or altogether averted. One of the most grievous of these is the constant destruction, by gamekeepers, of birds of prey and other animals, under the notion (often a very mistaken one) that they prey upon game birds or their eggs. That predatory birds, etc., do kill off, to some extent, the weaker species, cannot, we suppose, be disputed, but those which fall victims must generally be the weak, old, or diseased individuals; and it may very well be doubted whether the natural destruction of these would not be a benefit rather than a loss to the game-preserver. Disease amongst grouse used not to be so much heard of before the inauguration of the present system of "*vermin*"-killing. Much might be written upon this part of our subject, but the present is not the place to enter further into it. Whether the various field clubs could, by the distribution of printed appeals to landowners and game-preservers, do anything to stay this gradual extermination of our most interesting *feræ naturæ,* is a matter well worthy of their consideration. If an intelligent interest in natural history could be communicated to the gamekeepers and their masters, much would be done to stay the havoc. The wholesale destruction of small birds by indiscriminate bird-nesting in the neighbourhood of large villages and towns is another growing evil. In some districts where song-birds used not long ago to be abundant, they are now becoming lamentably scarce. It is needless, here, to dwell upon the destruction thus indirectly caused to trees and crops by the multiplication of insect pests, which should have formed the natural food of the smaller birds. So true is it that not one of nature's arrangements can be broken without causing a wide-spread disorganization. The extermination of rare plants and ferns is perhaps a smaller evil, but still a grievous one; moreover, it is generally brought about by hands more polite than those of gamekeepers and country lads, perhaps even by members of field clubs themselves. It is difficult, too, to speak in very sweeping terms in condemnation of it, for when a man really wants a plant for his herbarium, or a fern for his greenhouse, it is hard to say he may not take it. We would exhort the botanist to be content with the *flower,* and to leave the root; the fern-grower to pause awhile, and think of Wordsworth's beautiful lines—

> "Ere from the mutilated bower I turned
> Exulting, rich beyond the wealth of kings,
> I felt a sense of pain when I beheld
> The silent trees, and saw the intruding sky.
> Then, dearest maiden, move along these shades
> In gentleness of heart; with gentle hand
> Touch—for there is a spirit in the woods."

Yes, kind reader, leave the fern; so, in the aftertime, shall it often in its quiet, unmolested beauty, "flash upon that inward eye which is the bliss of solitude."

There is even some risk of plants once tolerably common becoming rare, owing to the constant depredations of collectors. A very few years ago in far Easedale, an unfrequented glen near Grasmere, the banks of the stream were rich with forests of *Osmunda regalis*. Last autumn I heard that not a plant remained. From the more accessible habitats of Rydal and Grasmere it has long disappeared, though it once fringed the lake with a luxuriant beauty which sent De Quincey into raptures, and drew from Wordsworth a line which the Opium-eater styles "the most beautiful independent line in the whole records of poetry"—

> "Fair ferns and flowers, and chiefly that tall fern,
> So stately, of the Queen Osmunda named;
> Plant lovelier, in its own retired abode
> On Grasmiere's beach, than naiad by the side
> Of Grecian brook, or Lady of the Mere,
> *Sole-sitting by the shores of old romance.*"

OUTLINES OF METEORIC ASTRONOMY.

BY A. S. HERSCHEL, B.A.

(1.) The history of Meteoric Astronomy may be briefly divided into four periods—of Speculation, Observation, Explanation, and Prediction. The first of these periods dates from the time of Aristotle (330 B.C.) to the time of Cornelius Gemma (A.D. 1450). In the absence of any evidence to the contrary, we may suppose the opinions of Aristotle to have prevailed during the whole of the period, and the following summary of his views is derived from the chapter of his works in which he treats of meteorology.

The Principle of Heat, or "Phlogiston," to borrow a word from later chemical writers, must, he says, levitate, or tend upwards, while all other known bodies gravitate towards the earth. Suppose that, by combining with "phlogiston," large quantities of humid and terrestrial vapours have been elevated to the summit of the atmosphere, they will there come into immediate contact with the revolving celestial sphere, and the "phlogiston" being set free by friction they inflame, and the northern-lights are produced. When the vapours are drawn up in a column and kindled at the summit of the atmosphere, a fire-ball is generated, just as a flame runs

down the smoke and gas when a lighted match is approached to the wick of a smouldering taper. Other vapours again are too heavy to be lifted completely to the summit of the atmosphere, which is the native region of heat. The "phlogiston" then escapes upwards, and projects downwards the ponderating vapours, as a cherry-stone is jerked from between the finger and the thumb. These are the shooting-stars. Aristotle regarded aërolites as having been carried up into the air by whirlwinds, and thence let fall. Anaxagoras, on the contrary, believed them to be pieces of the heavenly bodies.

(2.) A century after the time of Cornelius Gemma, whose work illustrates the views of Aristotle, Copernicus and Galileo flourished at the end of the 16th, and Kepler at the beginning of the 17th century. These astronomers combined to raise the science of astronomy to a new point of perfection by their observations, and Kepler was the first to publish an "Ephemerides," or yearly journal of his observations, in one of which there is described a fire-ball that passed over the whole of Austria from east to west with a terrific explosion, on the 17th of November, 1623. On the 31st of March, 1667, a similar detonating fire-ball was observed in Italy, and described by Montanari. A meteor was seen at twilight in England on the 20th of September, 1676, and taken by Wallis to have been a comet. A detonating meteor that visited England on the 19th of March, 1719, was described by Halley, and attributed to the combustible gases imagined by Aristotle. This meteor was, he thought, seventy miles high, and, therefore, at the very summit of the atmosphere, and the great explosions were explained by remarking that they might very well be caused by gas, which often produces in coal mines frightful catastrophes. These meteors he recommended for the future to be carefully observed, in order thereby to determine the longitudes of distant places. These recommendations, Lynn, a few years later, extended to shooting-stars, for he observed that they were never noticed on cloudy nights, and must therefore always stay a considerable height above the clouds. Saussure and Spallanzani, also, at the end of the last century, on the Alps and Appenines, remarked that they appeared to be quite as high above their heads from the tops of mountains, as they usually appear from the level of the plains below. Two students at Göttingen, Brandes and Benzenberg, determined, in 1798, to sift this question to the bottom. An opinion had sprung up in Germany, of which a short outline may very well serve as an introduction to the third period, or that of explanation, in the history of shooting stars.

(3.) In the choir of the cathedral at Ensisheim (Alsace) there was preserved, until recently, a dark-looking stone

of large size, with a strange inscription, written in three languages, Latin, French, and German :—

> "In fourteen hundred ninety-two
> There happened here a great ado;
> For close without, before the town,
> The seventh of November's moon,
> A stone was fall'n and there it lay,
> With thunder, and in open day!
> Two hundred and a half it weighed.
> Its colour iron. Then they made
> Procession, and 'twas hither borne,
> But much by force from it was torn."

The remainder of the stone, weighing only 16 lbs., was removed to the Museum of Natural History in Paris, where it is the most ancient known example of an aërolite of which authentic accounts have been preserved. Many such instances were however not wanting in later years, and a monk was struck and killed at Padua by an aërolite in 1660. Toaldo on this occasion proposed to consider them as projected from volcanoes on the moon. More recently, namely, in the year 1768, not less than three aërolites fell in different parts of France. Of these the stone of Lucé was given to be analysed by the French Academy to the great chemist Lavoisier, who four years later returned his opinion that the reputed meteorite was a mass of iron pyrites that had been disfigured by lightning, and at the same time exposed to view in the place where it was found. This mistaken verdict of Lavoisier led to the error by which certain nodules of iron pyrites having a rough surface and radiated structure are still vulgarly known in England by the name of "thunderbolts." These of course are totally earthy concretions, altogether different in their nature and origin from real meteoric stones. Montanari and Ferret had proposed to consider that aërolites are projected by earthly volcanoes, and Jussieu laboured to prove that aërolites are at least a different class of minerals from fossil shells or flint arrow-heads and implements. Nevertheless, after the verdict of Lavoisier, the reality of such occurrences was wholly discredited in France. Nor was opinion more settled with regard to luminous meteors, but one meteorologist, Toaldo, ascribed all fiery meteors to the combustion of pure "Phlogiston," or hydrogen, and Muschenbroeck attributed shooting-stars, like Aristotle, to humid exhalations from the ground, especially in marshy places, where, and on the banks of rivers, he remarked, their gelatinous residues might often be discovered on the ground. In 1752, Franklin and Dalibard discovered the source of lightning in atmospheric electricity. This discovery acquired great fame, and Pringle, in 1758, and Blagden in 1783, attributed to this agent the two remark-

able fire-balls observed in England in those years. The discharge of electricity is, unfortunately for this theory, exceedingly diffuse in thin air, while the light of fire-balls is brilliant and intense. The explanation of luminous meteors now generally accepted is that due to Chladni, of Wittemberg, well known for his researches in the theory of sound, and from whom are named the figures formed on glass and other flat surfaces, when strewed with sand, and made to vibrate with a musical note. Chladni visited Göttingen in 1792, where he became acquainted with Lichtenberg's electrical experiments, and was induced to reject the electrical theory of luminous meteors as altogether untenable. The work in which the new views of Chaldni were made known was published in April, 1794, under the title, "*The iron of Pallas and other masses of stone and iron reputed to have fallen from the air.*" In this work, Chladni supposes that all the accounts hitherto received of the falls of aërolites were founded in reality, and conjectures that the planetary velocity with which these bodies enter the air is sufficient, by compressing the air, to raise them to a heat of vivid ignition. The property of compressed air here assumed can be made evident by an instrument called a fire-syringe, in which air confined by a piston in a tube, and moderately compressed, readily ignites punk, tinder, or amadou. With greater compression a proportionately greater effect might be produced. In this way, not only the fused surfaces of aërolites, but also fire-balls and shooting-stars can be accounted for. It is only necessary to suppose that the latter kinds of meteors are so small as to be consumed before they enter the atmosphere to any depth, and both shooting-stars and fire-balls will be seen to be the same class of bodies as aërolites on a smaller scale.

(4.) To test this theory, Brandes and Benzenberg, in 1798, undertook to determine the heights and velocities of shooting-stars under the direction of Lichtenberg. The heights were found to be in perfect agreement with Chladni's supposition. Fire-balls and shooting-stars occur, namely, at a common height of forty to eighty miles above the surface of the earth. Their velocity is somewhat greater than that of the earth in its orbit, and (although they may sometimes *appear* to do so) they in reality never shoot upwards, but always downwards towards the earth. In this way Chladni's position was fully confirmed, and more attention came to be paid to the fall of aërolites than they had ever before received. A variety of explanations was at this time hazarded to account for the presence of the flying particles in space. Among these the theory of Toaldo, that meteorites were stones projected by volcanoes from the moon, obtained the most adherents, and

was advocated in succession by Olbers, Laplace, Poisson, Biot, and others. Lichtenberg was also of the same opinion, and as late as the year 1839, Benzenberg affirmed that shooting-stars migrated from the moon. He quoted Lichtenberg's remark, that "the moon was a bad neighbour to the earth, and pelted her with stones." Laplace and Poisson, however, abandoned this explanation on the ground that no projectile forces exist upon the earth or moon sufficient to eject the stones with planetary velocity. The native source and origin of fire-balls, shooting-stars, and aërolites, still remained to be discovered; and some advance in this direction was shortly afterwards effected by an extraordinary occurrence in America. On the morning of the 13th November, 1833, there was witnessed in the United States of America such a surpassing shower of luminous meteors that every description of the display appears to have fallen short of the reality. One fact, however, remained certain, that a perfectly similar shower to this was observed by Humboldt in Cumana on the morning of the 13th November, 1799; and another, that the meteors streamed outwards on all sides from the direction of a fixed point near the star *Gamma Leonis*, during the continuance of the shower. These two particulars Arago, the late French astronomer, declared to be decisive in favour of a new theory for the origin of luminous meteors. "They are," he said, "a new planetary world, beginning to be revealed to us;" they circulate *like planets* round the sun. Shooting-stars obey the Newtonian law of gravitation, and their orbits may be calculated like those of the planets or the moon. It is now a fact well proved by evidence that the November meteors return in their greatest magnificence every thirty-three years, so that their next central conjunction with the earth will take place on the 13th or 14th November, 1866.

(5.) Another date for periodical meteors, namely the 10th of August, was shortly afterwards discovered by M. Quetelet at Brussels, in 1836, and at this epoch may properly be said to commence the period of prediction. M. Quetelet predicted the return of this shower on the following 10th August, 1837, and the prediction was fully confirmed, and has not failed since to be verified in Brussels every succeeding year. M. Quetelet, moreover, prepared Catalogues of Star-showers in 1839 and 1841, and specified particular dates for their return, all of which, as will presently be shown, have since been verified. Of these showers, the meteors of the 10th of August, although not the brightest, are the most regular in their return. They appear to fail every eighth year, the last minimum having taken place in 1862; but the display of August 10th, 1863, is probably the brightest star-shower that has been witnessed in

England since the night of November 12th—13th, 1832, when it is related the horses of the mail between York and Richmond were terrified by the brightness of the meteors. Shooting-stars are now better observed, by awaiting their arrival every year upon the 10th of August, than they could have been at any former period of their history. Star-showers also return (but not regularly) on the 2nd January; 9th—10th, and 20th—26th April; 25th—30th July; 15th—23rd October; and 6th—12th December; with their radiant points respectively at υ Herculis, δ Virginis, α Lyræ, γ Cygni, ν Orionis, and θ Geminorum.

(6.) On the 10th of August, 1863, the tracks of twenty meteors were observed at the English national observatories in such a manner as to determine their heights and velocities with precision. On comparing these results with nearly two hundred instances formerly observed, a remarkable uniformity is discovered, and it may be stated on an average, with an error of not more than two or three miles, that shooting-stars, from the smallest visible to those as bright as the planets, appear at seventy-three, and disappear at fifty-two miles above the surface of the earth. Either a different composition must prevail in the second forty miles of the earth's atmosphere to account for this remarkable uniformity (perhaps the fluid which, according to Mr. Airy, occasions magnetic storms), or else we must admit that shooting-stars, whatever their size and splendour, are composed of such fragile materials, that they are all alike dissipated by an equal opposition of resistance. The lower portion of forty miles is generally called the crepuscular atmosphere from its giving rise to the phenomenon of twilight. The upper portion of forty miles might, in the absence of any other name, be termed the meteoric atmosphere, because it generates the light of meteors, but M. Quetelet assigns the names of stable and unstable to the upper and lower portions of the atmosphere.

(7.) Not only periodical meteors, but also ordinary shooting-stars, which may be observed in small numbers every night, are shown to belong to showers, many of which at present are as well determined as of those of August and November. They return with their attendant radiant points, without confusion or chance, at regular seasons of the year. Although not so rich in meteors, they are even more regular in their return, more constant and long enduring than the extraordinary occurrences of star-showers. The latter are evidently groups in circulation round the sun, but the meteors of August must compose a narrow ring encompassing the sun, for otherwise they could not return, on one and the same date, regularly every year, with only a single interruption,

and that apparently a small one, every eighth year. The ordinary, or general star-showers, on the other hand, compose belts of vast extent, and must either be the embers of former star-showers now absorbed by the earth, or else the original distribution of meteoric matter round the sun in its primitive unaffected order. We may suppose this matter to have been in a state of dust or infinitesimal division, so that in general the ordinary star-showers represent the primitive prevailing currents. Occasionally, and at some places, the currents of microscopic dust are found concentrated into shooting-stars; and these, by some unknown predisposing cause, have been collected into star-showers. Finally, it would appear that fire-balls themselves are nothing more than the compacted elements of star-showers.

(8.) On the morning of the 19th of October, 1863, a very luminous fire-ball was observed at Athens, under highly advantageous circumstances, by Dr. Schmidt, in such a manner as to illustrate by a striking example the ordinary composition of these meteors. The fire-ball advanced slowly through an arc of 80°, and during fourteen seconds it was kept in view by Dr. Schmidt in the field of a comet-seeker telescope magnifying eight diameters. The meteor appeared twin, or double, followed by a multitude of lesser companions, all of these advancing with parallel paths and drawing behind them parallel trains of light. Similar followers were visible to the naked eye, in a striking manner, in the great meteor of the 18th of August, 1783. In Cavallo's drawing (taken near London), there are depicted eleven such; in Robinson's (Newark) nineteen; and in Sanby's (Windsor Castle) there are thirty-eight followers to the meteor. In ordinary cases they follow the body of light so closely as to give the meteor an elongated appearance, compared to a wheatsheaf, a fish, a ninepin, etc., but at other times the meteor appears divided, double, or pursued by two or three balls, as in the case of Pringle's meteor of 1758, and the great meteor in America, on the 20th July, 1860. The ordinary forms are kite-shaped, pear-shaped, or globular. Besides the followers, a permanent streak often remains upon the track of a fire-ball, either fading away quickly or continuing visible for many minutes after the disappearance of the meteor. In the latter case it rarely remains straight, but changes its shape and position very sensibly, like a cloud transported by the wind. In all these respects, fire-balls resemble gigantic shooting-stars.

(9.) The heights of eleven fire-balls in England, in the years 1861-2, were found to be from 102 to 30 miles above earth's surface at the moments of first appearance and disappearance. Nearly fifty fire-balls observed before the date in question

(in the Old and New World), present the average values of 62 and 35 miles. The upper limit appears therefore sufficiently uncertain; but the lower limit is more depressed in the air than in the case of shooting-stars. Fire-balls which penetrate to within twenty miles of the earth's surface, generally produce violent concussions in the air, and are called *Detonating* fire-balls. These frequently precipitate stones upon the ground, and are occasionally called *Aërolitic* meteors, to distinguish them from the class of silent fire-balls, or *Bolides.* Bolides vary in magnitude from the apparent diameters of the planets to fire-balls which throw shadows, and are often brilliant and surprising objects at noonday. The velocities of bolides, as well as of detonating fire-balls, average more than thirty miles per second, and no distinction can be drawn in this respect between shooting-stars and fire-balls.

(10.) The coincidence of dates and directions evince the common origin of bolides and periodical shooting-stars. Only those fire-balls which are truly aërolitic will, it appears, require to be explained in a different manner. Among the 240,000 meteors said to have been visible above the horizon in America, during the night of the 12th—13th November, 1833, a considerable proportion consisted of fire-balls, varying in brightness from the apparent magnitudes of Jupiter and Venus to that of the Moon. The same was also observed in England, though on a less striking scale, on the night of the 10th of August, 1863. Shooting-stars and small bolides radiated on that night from ten o'clock till midnight, from the direction of the usual radiant point in Perseus. Again, a catalogue of nearly 1500 fire-balls, compiled from all previous catalogues, and from other independent sources, by Mr. Greg, shows that a large preponderance of fire-balls were observed on the dates of the 10th of August, 13th of November, and 6th—12th of December. Aërolites, on the contrary, are wanting on the same dates; for if the aërolitic date on the 13th—14th of December may be omitted, there is no approximation of aërolites to the star-showers of August and November. Fire-balls are shown by the catalogue to be abundant on the 10th of April and 18th of October, and on both of these dates star-showers have been observed. There appears therefore a variety of evidence to show that shooting-stars and fire-balls have a common origin; and furthermore that the sun is irregularly encompassed by zones of meteoric dust, concentrated at some points into shooting-stars and bolides, which by some unknown predisposing cause have been collected into star-showers. The concentration of the materials appears to have taken place without consolidation, nevertheless some portions might be so far compacted by chemical affinities or crystallization, as to

enter the atmosphere deep enough to produce concussions, but not to reach the ground. Aërolites, it will presently be seen, cannot have owed their origin to such a process.

(11.) The falls of aërolites must be reckoned very rare occurrences in England, but in Europe the number of falls recorded since the beginning of the last century to the present time exceeds 130. Aërolites are not (by any means) so frequent as earthquakes, but so violent are their concussions in the air, that they may have been at times mistaken for this cause. Some might also occur at night, and many in unfrequented parts, which could not be recovered and transmitted to museums. If the number preserved is reckoned at one-tenth part of those which have really fallen, this amounts on a moderate estimate to one meteorite per diem on the whole surface of the sea and land. This department of science is therefore likely to be extended by the increased facilities of intelligence and intercommunication which prevail in every part of the inhabited globe. At Barbotan, in the South of France, a perfect hail of stones took place on the evening of the 24th of July, 1790, from a large meteor which burst over the town, so that the inhabitants ran for refuge in their houses. This report was generally disbelieved in France, but specimens were nevertheless preserved in private collections. A shower of stones was again reported to have taken place at L'Aigle, in Normandy, on the 26th of April, 1803. J. B. Biot, an Academician from Paris, was deputed to inquire into the truth of these reports. Having provided himself with a specimen of the Barbotan stones, Biot proceeded to the spot, and soon assured himself of the truth of all that was related. Biot himself dug up a stone from the ground where it had fallen, and in a few days returned to the Academy the following report:—

"1. A violent explosion was heard at L'Aigle and for 80 miles in all the country round, about one p.m. on the 26th of April, 1803.

"2. A few minutes before the explosion was heard at L'Aigle, a luminous meteor with a very rapid motion was seen in the air, not at L'Aigle, but at several very distant places round.

"3. The explosion that was heard at L'Aigle was the consequence of the luminous meteor which burst in the air.

"4. Stones fell from the sky on the 26th of April, 1803."

More than 2000 stones fell, upon trees, pavements, and the roofs of houses, so hot at the moment of their fall as to burn the fingers when incautiously handled. One person was grazed by a stone upon the arm. This shower of stones extended over an area of oval figure nine miles long from south to north, and six miles wide. In this respect it was perfectly

similar to the shower of stones which fell at Stannern, between Prague and Vienna, on the 22nd of May, 1812. At six o'clock in the morning, after violent concussions, followed by rumbling noises for six or eight minutes, nearly 200 stones fell in the fields round Stannern, and were brought from the high road to the village in great numbers. Von Schreibers, who reported this stonefall to the Vienna Academy, collected sixty-one specimens of the stones, and consigned them to the Imperial Museum, where the greater number may still be seen. At the time of the stonefall at L'Aigle, only three specimens of aërolites were to be found in the Imperial Museum at Vienna, namely those of Ensisheim, Mauerkirchen, and Eichstädt, but after the occurrence of that at Stannern greater interest was awakened, and the Museum at the present day contains 220 specimens of meteorites. It is only exceeded in this respect by the magnificent collection at present exhibited at the British Museum.

(12.) The meteorites of Barbotan, L'Aigle, and Stannern are memorable instances of aërolitic showers. They must, in the opinion of Haidinger, of Vienna, have entered the air as a crowd or swarm of stones; but instances of solitary meteorites have also been abundantly recorded, of which the following are examples. The meteorite of Ensisheim, already mentioned above, is the earliest existing instance, and the large stone which fell in Yorkshire on the 13th of December, 1795, should be a familiar example to all who have visited the department of minerals exhibited at the British Museum. It is a cubical block weighing 56 lbs. The large meteorite which fell at Juvinas (Ardéche) in France, on the 15th June, 1821, although similar in its texture and minerals to the aërolites of Stannern, was a solitary stone. It weighs 220 lbs. Of meteorites which fell in smaller numbers those only need be noticed in which the height and velocity of the attendant fire-ball was accurately determined. The meteorites of Weston, in America, fell at daybreak on the morning of the 13th December, 1807, a date, like the 13th of October, justly rendered famous for aërolitic falls. The stones were few in number, and fell at three points of the meteor's path, corresponding, according to Bowditch, to three explosions which took place at heights of twenty-five to sixteen miles above the earth. The velocity of the meteor was estimated by Prof. Bowditch at only three miles per second. The two stones which fell at Charsonville, near Orleans, in France, on the 23rd November, 1810, were preceded by a fire-ball, of which the explosion and disappearance was estimated by Dutrochet at seventeen miles above the earth. They weighed 40 lbs. and 20 lbs. respectively, and are crossed by dark veins which give the mass a marble-like appearance. The meteorites

of Orgueil (in the south of France) fell at evening on the 14th of May, 1864, from a meteor apparently as large as the full-moon, which moved from east to west with a velocity of fourteen miles per second, descending from a height of forty to sixty miles above Nerac to fifteen or twenty miles above the town of Orgueil, where it burst, and the stones were scattered over several miles. They contain an unusual quantity of carbon, sulphate of ammonia, and other salts. The explosions of aërolites have been compared to those of "Prince Rupert's drops," small beads of glass brought into a high state of tension by sudden change of temperature at the surface. On the slightest fracture, they fly into a thousand pieces. This explanation is however doubtful: at least the stones so described cannot be made to decrepitate in the flame of the oxy-hydrogen blow-pipe. In the few instances, soon to be described, where disruption has certainly occurred, this took place when the heat on the surface had subsided. In ordinary cases separate fragments of meteorites cannot be fitted together into a single block.

(13.) Aërolites are invariably covered with a dark crust, not thicker than an ordinary playing-card, of their own substance, fused or molten into slag. This is evidently caused by the heat of the fire-ball by which at first they are surrounded. Chladni and Vauquelin supposed that the dark veins in the stones of Charsonville were portions of the black crust, cementing together broken pieces of the stone. Certain falls have, however, occurred to prove that no slag is formed upon meteorites after the time that they are broken by concussion. The meteorites of Quenggouk (in Pegu) for example, which fell on the 27th December, 1857, fit so exactly to one another at the surfaces which have not been crusted over, that the meteorite evidently parted after the fire-ball ceased to melt the surface. These pieces were discovered a mile apart. The meteorites of Butsura, which fell near Goorka, in India, on the 12th of May, 1861, are a more striking example in point. Five stones, in this case, weighing together more than 30 lbs., being joined together by their fresh uncoated surfaces, fit so exactly into one large uniformly crusted mass, that two fragments only are wanting at the angles to prove that the stone was only broken in pieces when the heat of the fire-ball had ceased to have any effect upon it. These fragments of a meteorite were found at four different places, lying two to three or even four miles distant from one another. Sections of this meteorite and its model are exhibited in the British Museum. With regard to veined stones like those of Charsonville, the opinion of Berzelius is more defensible that the black veins were formed in the primitive rock of which these stones are native pieces.

(14.) Some meteorites, called *aërosiderites,* are metallic iron, more or less alloyed with nickel. These kinds are generally found fossil, two only having been observed to fall from the sky, and these nearly a century apart. The first occurred at Agram in Croatia, on the 26th of May, 1751, weighing 72 lbs., and is preserved in the Imperial Museum at Vienna, where is also exhibited the aërosiderite of Braunau, that fell on the 14th of July, 1847. The largest fossil iron remains immoveably fixed in the desert of Bahia, in the Brazils. Another from La Plata, weighing 7 cwt., is exhibited in the British Museum. One was found at Var, in France; and recently a specimen, weighing 33 lbs., was dug up near Melrose, in Scotland. The iron of these blocks is nearly as regularly crystallized as a piece of ordinary spar, as may be shown by etching their polished surfaces with acid. Some meteorites (a good specimen is the meteorite of Hainholtz) are composed partly of iron and partly of stone. They are called *siderolites,* and the meteorite of Butsura, already mentioned, is not far removed from this class.

(15.) By far the greater majority of meteorites are *aërolites,* or stones resembling grey lava, with scattered grains of iron and pyrites, etc., and covered, as above described, with a shining or dull black crust. In their form they are rough, unshapen pieces, weighing from one to two hundredweights in the largest, and one or two ounces in the smallest specimens. The mixed minerals, mostly crystalline, of which they consist, have been studied with the microscope, and in the laboratory by chemical analysis. By the microscope they are shown to have been slowly consolidated from a state of fusion; and by analysis they are hardly to be distinguished from terrestrial lavas, excepting that iron, carbon, phosphorus, and nickel are present in a state uncombined with oxygen. Aërolites are, therefore, erupted or unerupted foreign lavas—specimens of the igneous frame of some unknown planet, melted in mountains, cooled in rocks, roughly broken off and projected into space. It deserves to be mentioned, as a curious coincidence, that the earliest well-known historical aërolite in existence, that of Ensisheim, fell upon the earth in the same year, and within a month of the same day, as that on which America was discovered by Columbus. The minerals brought back by Columbus and his contemporaries to the court of Spain did not furnish with more positive proofs of the existence in the Atlantic of a "New World," than the presence of a meteorite upon the globe supplies to astronomers, that planets are to be found in the vicinity of the earth, of which the positions and capabilities are not yet computed, even by Le Verrier and his most accomplished adherents. That bolides and shooting-stars owe their existence to belts of

matter in a state of extremely fine division encompassing the sun, it seems hardly possible to doubt. Aërolites, on the contrary, are fragments of solid stone, and of these the source and origin must at least be on a larger scale, and composed of the same materials. The conclusion appears inevitable that parent planets in the immediate vicinity of the earth, too small and powerless to reclaim their fragments, have scattered the lapideous morsels broadcast into space. These circulating round the sun with their initial projectile velocities, should the orbits of both intersect each other, must sooner or later encounter the earth.

(16.) It may be presumed that the suspected planets are situated within the orbit of the earth, because by far the greatest number of aërolites are experienced by day, while the sun is still above the horizon, and the largest detonating fire-balls occur about the time of sunset. In this way the passage of dark bodies across the disc of the sun, and more rarely across the disc of the moon, may be explained. For it can be calculated that a planet twelve miles in diameter, at ten times the moon's distance from the earth, subtending 1″ of arc at its passage across the sun, would appear as a morning and evening eighth magnitude star. But as at the time of its greatest brightness it would also be stationary, or nearly so, and almost lost in the rays of twilight, it is not impossible that such planets, if accidentally observed, should have been mistaken for fixed stars. Should the suspected planets, however, be situated outside the orbit of the earth, it is difficult to perceive how they could so long have eluded the gaze of our sharp-eyed astronomers, as their lustre in this case would be vastly superior. But in the meantime the bombardment of aërolites continues; and whatever may be their origin, some new light must before long be obtained from these "pocket-planets" themselves, as they have been termed by Humboldt, to settle the perplexing question, and to open out new fields for speculation.

INSTINCT OF BIRDS.

BY THE REV. JOHN WEBB.

THE following remarkable instance of instinct (or what we are pleased to call by that name) came under the observation of the writer :—

1863, July 26. *Scene*—Mrs. M.'s drawing-room. *Present:* Mrs. M——, Miss C. B——, Rev. J. W——. Two birds in two separate cages on the table—an Australian parroquet in a brass wire circular cage, with a hoop swing in it, the cage rather too small for the bird; a canary-bird in a cage of the shape of a parallelogram, larger, but with only a perch. The doors of each cage were opened, the doors of the room were closed, and the birds are set at liberty. At first they flutter about upon the chairs and tables, then amuse themselves by hopping about upon the carpet and picking up crumbs, now and then fluttering past each other without taking any particular notice. They had often been let out before; it was said that the canary bird was the master of the two. At last they make a little nearer approach; a few passes with the beak take place between them, but with little more than a flutter. At length the parroquet tries to bully his companion after the manner of the tribe, by facing him, and making a few rapid bows at him, without producing any very great impression. The canary-bird goes off to amuse himself, apparently not caring a straw about him; when, taking a few quiet steps (both cages having been placed on the ground), the parroquet advances to the door of his companion's cage—the larger cage of the two—hops upon the threshold, mounts upon the perch, and takes possession. This feat accomplished, the other, after a few *détours* about the room, discovers an intruder in his cage, sidles towards it, looks in, does not like the state of things, flutters off, makes two or three turns, hops on the threshold, looks in again, and is off again. When he was gone, the intruder descends from the perch, places himself upon the threshold, draws to the door with his beak, and with his beak makes it fast. What, is this an untaught bird? Is it instinct, or is it a spark of reason? The canary-bird perceives what he has done; got to the top of his own cage (which he had done before the door was shut), fluttered about to alarm the offender, who seemed to take no notice of it at all: he then made an expedition into the circular cage, did not like it, and came out again, fluttered about his own cage, got on the top of it, and appeared very uneasy.

One of the party present then opened the door of the canary-bird's cage, in which the intruder was sitting with

great composure. Presently the canary returned to his own home, entered, and placed himself upon the perch beside the parroquet. The latter at first took no notice; they had a few flutters about the cage, without any real fighting; the canary did not find it comfortable, and got out again, the other still keeping his hold. After this abandonment, while he was consoling himself by hopping about upon the carpet, the Australian descended from the perch to the threshold. And here he gave another proof of his sagacity; the door being wide open, and more difficult to draw to than when, as in the former instance, it was half open, after two or three ineffectual efforts with his beak to bring it to, he hopped down, went to the end furthest from the hinge, drew it half to, placed himself upon the threshold, finished the operation by closing it and fastening the wire latch once more. It remains to be added that the canary-bird, finding it impossible to get in, took possession of the other cage, but had not the wit to close the door of that, which was closed for him. Here a long struggle took place; he could not fix himself comfortably upon the perch; the swing hung too low, and in attempting to place himself in the centre, the swing came against his sides, and he continued to flutter from one end of the perch to the other, the swing still keeping in motion. At length, after many useless efforts, the swing hanging rather transversely and affording him a trifle more room on the one side than on the other, he selected the widest aperture of the two, trifling as the difference was, and the evening being now advanced, tucked his head under his wing, and went to sleep. Thus they passed their night. It is but right to add, that ultimately justice was done, and they were restored to their cages on the morrow.

THE PARTRIDGES OF BENGAL.

BY R. C. BEAVAN, LIEUT. BENGAL SURVEY DEPARTMENT.

There are three kinds of partridges commonly found in Bengal. The grey partridge (*Perdix Ponticeriana*, Hardwicke, *Ill. Ind. Zool.*, col. plate 213), the "*Gora tetur*" of the natives, is a bird very much like its English congener in colour, but a trifle smaller. It affords fair sport for the gun, but unless properly dressed, is not thought much of for the spit, being generally hard and dry. They are invariably found in pairs, in low bushy scrub, where the soil is dry, and occur in great abundance in the Rajhmahal Hills, the slopes of which are covered with low, thick, and thorny bushes, growing in a dry, stony soil.

The general method of shooting them is to employ beaters, who, armed with long sticks, and almost nude, work willingly the whole day for a few coppers, and forming line through the jungle, drive everything out before them.

This jungle seldom exceeds five feet in height, and the plan usually followed is for one or two of the guns to go ahead and look out for chances, while the remainder march with the beaters. The game thus procured consists generally, in the districts I am alluding to, of these "grey" partridges, hares, and quail, and it is well to have a servant near with a rifle, as often a deer or hog is disturbed, and sometimes even a tiger.

The grey partridge does not seem to care much about water, being generally found in very dry country, at some distance from cultivation or crops of any kind; its food consists chiefly of grass seeds, jungle berries, insects, and occasionally dhar or rice, when the fields of the latter run up, as they do in Maunbloom, between patches of thick cover.

The difference of the sexes is not perceptible outwardly, except by the spurs, with which the male bird is armed; these are very slightly developed in the female. According to Mr. Blyth, the habitat of this bird extends throughout India generally, as far as Ceylon, but it is not found to the east of the Bay of Bengal. The call of this species is loud and clear.

We next come to the black partridge (*Francolinus vulgaris*, Stephens, pl. 147, 148), called "*Kala tetur*" in Hindostanee. It is a much handsomer and finer bird than the grey, affording better sport, and considered equally superior for the spit. It is about the size of the English partridge, perhaps slightly larger. The greater part of the plumage of the male bird is black, varied with dark brown on the wings, and spotted sparingly with white on the breast; but the female is of a more

sober hue, a mottled grey and white, delicately pencilled in parts with dark brown.

Dogs are of great assistance in shooting this species, as they run but little, compared with the grey, afford good scent, and are often found in or near dry cultivation. I use the word *dry* advisedly; they are not found in *wet* or *rice* cultivation. They almost invariably get up in pairs. As far as my experience goes I have never seen or heard of such a thing as a *covey* of partridges in Bengal, three or four are sometimes found together, but they invariably, when disturbed, fly off in pairs.

The usual habitat of these birds is grass about three feet high, not far from water. They also frequent the fields of "*rahr dall*," a kind of pea grown largely in some districts to four or five feet in height, and affording good cover. Where plentiful, they give very good sport either with dogs or beaters, and make a welcome addition to the cuisine of a hungry traveller. They have a peculiar sibilating call, low but clear, very much like that of the English grasshopper lark, at one moment appearing to issue from the grass close by, at another some hundred yards off. Their food consists of grain and various grass seeds. They are to be found plentifully in the dry grass savannahs bordering the Ganges, to the north of Moorshedabad and the base of the Rajhmahal Hills, and in all favourable localities in Upper Bengal. The range of this bird seems large. Blyth, in his catalogue, gives Afghanistan, Persia, Syria, Cyprus, Sicily, and North India, as their habitat. I have found them abundant in the Maunbhoom jungles, and they probably extend as far south as Midnapore.

A third species is the khyer partridge, *Perdix gularis*, Tem. (Hardwicke, *Ill. Ind. Zool.*), sometimes called the Bengal chickoor, or wood partridge. This is a large bird, and weighs, when full grown, 1½ lb. In several places along the banks of the Ganges, and of some of the other large rivers in Bengal, there is a strip of low land on either side, which is periodically flooded when the rain causes the rivers to rise. On their subsiding, this soon gets covered with a thick jungly growth of high reeds, intermingled with thorny bushes of a white dog-rose, which together form an almost impenetrable mass of vegetation, in places some 16 or 20 feet high, affording capital cover for wild buffaloes, pigs, deer, etc. On the gradual fall of the river Ganges, various irregularities in the ground in this tract of country remain filled with water, forming small lakes, which, scattered here and there, soon get surrounded by the above-named dense vegetation. In the beginning of the cold weather, one can run up by train from Calcutta, and in one day reach these fine shooting grounds, which extend for miles along the base of the Rajhmahal Hills,

and the Caragola side of the river, and are invariably well stocked with these partridges. They are always found close to these small pools of water, and frequent the densest part of the high reeds. If one attempts to beat them up in the day time it is necessary to force a way through the tangled mass on an elephant; and though, with five or six more as beaters, plenty of birds will be put up, it is extremely difficult to recover them when they fall into the thick jungle. The best plan is to go out with men as beaters, either in the morning or evening, when the birds leave their almost impenetrable coverts, and venture out into the lower grass to feed; then capital sport may be had, as on rising they immediately make for the thick cover, and when beating at right angles to it, must necessarily pass along the whole line. The gun nearest the cover has, of course, the best chance; but unless he kills his bird dead, it is quite useless hunting for a wounded one in the tangled mass. They often perch upon the rose bushes, and give good chances to the pot-hunter. The bird is of a grey colour, handsomely barred across the thigh coverts with brown, and streaked on the breast with the same colour. It is quick in flight, and requires a hard blow to bring to bag; and last, though not least, is capital eating. Its range appears limited to the country between the Himalayas and the Ganges, and not higher up that river than Benares.

Near Caragola Ghaut a couple of good guns may in a few hours bag eighteen or twenty brace, with about a dozen or twenty beaters, which is very good sport indeed for India, where birds are never preserved. The high reeds that form this thick cover are the same that, cut in small pieces, are sold all over India for the purpose of making pens suitable for writing the native character. When cut down close the stumps are rather dangerous, often piercing the boot and running into the foot; but if, on the other hand, one discards this open but thorny ground, another danger is likely to occur, which once happened to a friend. As he was raising his gun to fire at a bird which had just got up, one of these reeds caught in the trigger, the gun went off while yet low, and the charge penetrated a thick bush a little ahead of the beaters, from which immediately issued a series of terrible shrieks. Soon, two small boys were brought to light, badly lacerated by shot, one with his eye put out. It appeared that, contrary to orders, they had smuggled themselves in with the rest of the beaters, in the hope of getting a few pice, and being so small, had managed to wriggle ahead more easily than the men through the reeds. They were both sent off to the nearest hospital, distant thirty miles, and their disconsolate parents easily comforted with a present of a few rupees.

The fourth, and last, Bengal species is, from its limited range, but little known. I allude to the double-spurred partridge, *Galloperdix lunulosa* (Hardwicke, *Ill. Ind. Zool.*, and Jerdon, *Ill. Ind. Zool.*, pl. 42), generally called the Spur Fowl. It is about the size of the grey partridge, but much handsomer. It is coloured with a kind of dark bronze on the wing coverts, which gives to the bird when first shot the appearance of a general green hue. This fades after death, and it then appears dark brown on the back, blackish about the head, neck, and tail, and chrome yellow on the breast; the whole, except the tail, speckled with black and white lunules or spots.

This species is pretty common in the Rajhmahal Hills, near Hazareebaugh, and extends throughout the Maunbhoom jungles towards Midnapore. It is also found sparingly in Beerbhoom. Its native name in Maunbhoom is "*asko.*"

Its habits partake much of those of the jungle fowl, *Gallus ferrugineus*, which is also found in the same jungles. Its food consists of seeds, rice, grain, and the flowers of the *Mhowa* tree (*Bassia latifolia*), which abounds in the Maunbhoom district, and generally throughout Chota Nagpore, and is much sought out, when its waxy flowers fall, by all kinds of game, both winged and fourfooted. Bears and various species of deer are excessively fond of them, as also are the peacock, jungle fowl, and most partridges. The natives, too, collect and distil from them a spirit called dārū. This partridge does not give good sport. It frequents thick bushy jungles, and runs rapidly through it when disturbed, but is good eating when kept until tender.

LITERARY NOTICES.

Cosmogony, or the Principles of Terrestrial Physics. By Evan Hopkins, C.E., F.G.S., Author of "Geology and Magnetism." (Longmans.)—Mr. Evan Hopkins, like Mr. Kelly, whose lucubrations were noticed in our last number, desires to reform geology, so as to do away with the long periods supposed necessary for the formation of the various strata. He does not, however, resort to the steam-grinding apparatus of the last-named philosopher. His process is more simple. Electro-magnetism is the motive power on which he relies. He has convinced himself that, during the last 2140 years, "the entire surface of our globe has moved to the north-west in a spiral path 30°, and northward 12°." He invites us to reject any astronomical or geological doctrines that do not coincide with this hypothesis, and he tells us that "the south polar basin is the starting-point of the embryo of the crystalline film of our globe, *i.e.*, our terrestrial habitation; and the north polar basin is the receptacle of the final dissolution of all terrestrial substances."

Homes without Hands. By the Rev. J. G. Wood, M.A., F.L.S. (Longmans.)—The recent numbers of this entertaining work fully maintain Mr. Wood's reputation as an admirable popularizer of natural history. He comes in No. 14 to the weaver bird, the hive bee, the hornet, and several other sociable insects, the "homes" of which he describes. No. 15 contains an account of driver ants, mud wasps, and corder bees, and then passes to the curious question of parasitic nests, of which several illustrations are given, taken from the domestic economy of both birds and insects. The illustrations are, as usual, numerous and good; and we can only repeat what we have said in former articles, that "Homes without Hands" is a good and instructive family-book.

The Pauper, the Thief, and the Convict: Sketches of some of their Haunts, Homes, and Habits. By Thomas Archer, Author of "Wayfe Summer," "Madame Prudence," etc. (Groombridge and Sons.)—Few persons will go for themselves into the haunts of wretchedness in which town crime is so prolifically bred; nor will many become personally acquainted with the physiognomy of the workhouse or the jail. It is, however, an indispensable foundation for reformatory efforts, that the condition of the erring and suffering classes should be distinctly understood. In many cases, terrible poverty is patiently borne, without its immediately or directly leading to actual delinquency. This is the case when a once-thriving class like the Spitalfields weavers have become depressed, and still retain many heart-touching traits of tastes and habits which belonged to better days. Below these unfortunates are thousands who have not even the traditions of a happier state of things to fall back upon, and they furnish a constantly-recruited army of pauperism and crime. Mr. Archer has put into a compact, well-written book a great deal of information concerning our

depressed population. He gives enough of their dark surroundings and deplorable habits to make his picture striking as well as true, and he judiciously avoids details that are not fit for family reading. If the subject were not so intimately connected with human misery, we should call his pages very entertaining: interesting they certainly are, and carry their instruction with them. The chapters, "Amongst the Poor," "Tiger Bay," and "Weasels Asleep," strike us as excellent of their kind; and the book cannot fail to assist in rousing the intelligent and benevolent part of the community to the necessity of dealing, on a large and bold scale, with evils that minor efforts may expose, but cannot correct. Every large town has whole streets, or districts, which are nothing else than elaborately-arranged factories for the production of pauperism, disease, and crime. No circumstance of dirt, filth, darkness, bad ventilation, ignorance of what is good, and early acquaintance with what is bad, is wanting in these horrible localities; and although they may lie close to respectable or even wealthy neighbourhoods, they seem as far out of the influence of civilization, and as far removed from the eye of the happier portion of society, as if they were situated in a remote quarter of the globe. Mr. Archer's travels in such regions have enabled him to describe them with graphic power.

The Public Schools Calendar for 1865. Edited by a Graduate of the University of Oxford. (Rivingtons.)—This work is, we believe, quite new in the extent of its plan. Preference is given, as the preface tells us, to the nine public schools forming the subject of Her Majesty's Commissioners' Report. The school lists of these nine, and the roll of cadets at Woolwich, are given in full, as well as the honours' lists of all the schools. Various other schools are described, but the list does not pretend to include every school to which the name of "public" properly belongs. In future years, we should recommend an extension of the list; but we suppose to make it complete would change the size of the work. A great deal of information has been collected together concerning the studies, discipline, and amusements of the various schools, and the work supplies a void in this kind of literature which its editor has well filled up.

The Anthropological Review, No. 8. (Trübner and Co.)—There is interesting matter in this number, which includes the Journal of the Anthropological Society of London. We cannot say we admire the tone of the reviews. They lack a calm, philosophical spirit, and trench on the ludicrous in passages intended for fine writing. The most important paper is a reprint from the *Canadian Journal*, in which Dr. Wilson discusses the peculiarities of the ancient and modern Celt of Gaul and Great Britain. The information on the extent of the tendency towards an unsymmetrical development of heads is very curious.

The Astronomical Register.—The successive numbers of this useful periodical meet the wants of a considerable body of observers. The information supplied is generally very good; but one of the

contributors, who calls Uranus not worth looking at, except with very large telescopes, should not be attended to. A good 3-inch glass gives an image of this planet which it is very interesting to contrast with that afforded by any small star.

New Entozootic Malady: Observations on the Probable Introduction of this Formidable Disease, and on the almost inevitable Increase of Private Diseases in general, as a Consequence of the Proposed Utilization of Sewage. By T. Spencer Cobbold, F.R.S., F.S.L. (Groombridge.)—We recommend attention to Dr. Cobbold's "Entozoa," a work which embodies an immense collection of information relating to parasites. The utilization of sewage cannot be stopped by an alarmist pamphlet, but the knowledge conveyed in Dr. Cobbold's important treatise cannot be too widely diffused, if the great evil of parasitic disease is to be kept down.

Functional Diseases of the Stomach. Part I—Sea-sickness; Its Nature and Treatment. By John Chapman, M.D., M.R.C.P., M.R.C.S. (Trübner and Co.)—The discovery that the sympathetic nerve causes contraction of the blood-vessels led Dr. Chapman to believe that, by exciting or diminishing its action, he could diminish or augment circulation, and thus obtain a remedial power over certain disorders. Experiment verified his anticipations that circulation could be increased by applying cold to the back, and thus diminishing the contractile action exerted by the sympathetic on the arterial vessels. Dr. Chapman first employed his process on epileptic patients, and he now recommends a sausage-like bag filled with ice, and laid down the spine, as a cure for sea-sickness. Many cases are mentioned of the success of the plan, and the patients describe it as less uncomfortable than would be supposed. Perhaps a more complete study of narcotics will enable the same result to be accomplished by the aid of some substance having a specific action on the sympathetic system.

Heat Considered as a Mode of Motion. By John Tyndall, F.R.S., etc., Professor of Natural Philosophy in the Royal Institution, and in the Royal School of Mines. Second edition, with additions and illustrations. (Longmans.)—We are glad to welcome a second edition of this admirable work, which is increased by some seventy pages of new matter, embodying researches completed since the publication of the first edition. It is undoubtedly one of the most valuable and profound books which this generation has produced. And the learned professor deserves great praise for avoiding the besetting sin of ordinary scientific men, who seem to fancy that their reputation for wisdom will be increased by the dryness of their style and the number of unintelligible words they employ. Professor Tyndall is eloquent, simple, and clear, exemplifying the double genius of discovery and exposition.

The Old City and its Highways and Byways: Sketches of Curious Customs, Characters, Incidents, Scenes, and Events, illustrative of London Life in Olden Times. By "Aleph," author of "London Scenes and London People." (Collingridge.)—This is another of

"Aleph's" pleasant, gossiping books about London, which is all the more valuable, as the rapid changes going on in the metropolis lead to the rapid destruction of the architectural and other links between the present and the past. The subjects touched upon in this volume are very numerous, beginning with a "Bargain at the Auction Mart," and ending with "Twelfth Day" as it was celebrated by our forefathers. "Milton as a Londoner" is a very agreeable paper. "Aleph" is evidently a fervent admirer of the great poet, although his political sympathies are the very opposite of Milton's. The sketch of "James Lackington" is another good paper, and, indeed, we might find something commendatory to say of each. The illustrations—three dozen in number—are well executed, and the volume presents a handsome and appropriate appearance, with its red edges and substantial binding.

ARCHÆOLOGIA.

At the meeting of the British Archæological Association, March 8, the Rev. E. Kell, F.S.A., gave an account of the discovery of Roman Buildings in the Isle of Wight, which form a rather important addition to our knowledge of the Roman occupation of that island. In the Roman period, a road ran across the Isle of Wight from north to south, from what is now called Gurnard, or Gurnet Bay, where it is called Rue Street, by way of Niton to Puckaster Cove, where there was, probably, a port for shipping. At the termination of this road, on the northern coast, the shores of Gurnet Bay have been much gained upon by the sea, which has left them in low cliffs. Under these cliffs, near the Rue Street, fragments of objects formed of metal, tiles, and other building materials, and other objects of evident antiquity, had been frequently picked up on the beach, but without attracting much interest, until, during the last autumn, the occurrence of Roman coins among the objects thus gathered up, excited the attention of a local inquirer, and he was led to examine more carefully the face of the cliff, in which he discovered, at about a foot below the top, the line of the floor of a building formed of small brick tessellæ. This led to excavations on the ground above the cliff, and the foundations and floors of buildings were uncovered. These buildings, which ran east and west, consisted of three distinct rooms, of no very large dimensions, the southern wall of which remained to a length of forty-two feet seven inches, and the northern wall, which had suffered greater dilapidations from the inroads of the sea, to an extent of thirty-five feet. Two of the rooms included within these walls were about fifteen feet long, by nearly ten feet wide, and were paved with the small square tiles which form the usual floors of the inferior rooms in Roman villas in Britain. The western termination of one of those rooms has been carried away in the fall of the cliff, but the other, or middle room, was found to be

perfect, except that the floor was much broken. In this room a quantity of broken Samian ware and other pottery, as well as a few coins, were found scattered about. To the east of this was the third room, which was entered from the apartment last described by a door, and had in the middle a large flat stone, on which, as we understood the description, ashes were found. On this account, we suppose, Mr. Kell assumes this stone to have been a fire-place, and the room a kitchen. In different parts of this room were found what Mr. Kell terms a bill-hook or chopper, the blade of which is six inches and a half long and three broad, and the handle eight inches and a half long, a knife handle, abundance of broken earthenware, chiefly of a coarse description, bones of animals, oyster and limpet shells, and one Roman coin. A consideration of these buildings can leave no doubt in our mind that they formed part (probably of one side of the court) of a considerable Roman villa, the principal apartments of which probably lay to the westward, and have all been washed away by the sea. The remains of charcoal and burnt materials scattered about show that, like most of the Roman villas in these islands, this had been destroyed by fire. A great abundance of roof-tiles and slabs of stone were also strewed over the floors and on the ground outside the walls; the roof-stones formed, as usual, in hexagons, so that by lapping over each other they formed lozenges.

The latest of the coins found in removing the remains of these buildings was of the Emperor Gratian, which brings us down to the latter part of the fourth century. The pottery consisted of some fragments of Samian ware, of no great interest, and of a quantity of broken earthenware of the common sorts usually found on Roman sites in Britain, some of which was identified with the ware, of which the potteries have been traced in the New Forest, at Crockle. Besides these objects, and a few fragments of iron and bronze, there were found a quantity of what Mr. Kell describes as "leaden tickets," which bear some resemblance, though rather distant, to the leaden Roman stamps found at Brough-upon-Stanmore, and described in a recent number of the INTELLECTUAL OBSERVER, in our notice of Mr. Roach Smith's *Collectanea Antiqua*. These "tickets," which are round, and about the size of an English farthing, are marked, some with letters, and others with ornaments. Mr. Kell suggests that they were used as tickets to some sort of merchandize of which a traffic was carried on in this direction; and he imagines, without any apparent reason, that they were connected with the ancient tin trade. A closer examination, however, tends to dissipate our ideas of their great antiquity; and, accordingly, Mr. Syer Cuming, the honorary secretary of the Archæological Association, declared that they were all of quite modern manufacture, and explained them in a manner which appeared perfectly satisfactory. A few of them appeared to be leaden weights which had been attached to fishermen's nets to make them sink, while the rest were the small leaden medalets or buttons called by boys *dumps*, and used for playing at a game to which boys give the same name. Mr. Kell mentioned several objects found on this site which were undoubtedly of

modern manufacture, among which were two or three leaden buttons, which he supposes may be of the fifteenth century; but he places among the genuine Samian ware a fragment of pottery of extremely beautiful workmanship, with ornament in relief, which was undoubtedly made in the seventeenth century.

This circumstance of finding OBJECTS OF MODERN MAKE AMONG ANTIQUITIES in the original and undisturbed deposit of the latter is a fact which has now been often observed, and is deserving of particular attention in connection with another class of researches carried on with great zeal at the present-day. It is no doubt the result of different accidents, some of which are easily understood, while others are more difficult of explanation. We have met with articles of modern manufacture lying on or near the floor of a deep Anglo-Saxon grave, which had never been opened, among the objects of the original deposit. This and other similar cases can only be explained by circumstances with which we are not well acquainted, but which caused the heavy body in those cases to sink gradually in the ground. Some years ago, when a tumulus, called British, was opened, we believe in East Yorkshire, a tobacco-pipe was found nearly in its centre, and the excavators supposed at first that they had found evidence of smoking among the ancient Britons; but when the pipe was examined by somebody acquainted with the history of pipe-making, it was pronounced to be of the age of James I. or Charles I. As there were indications of old disturbance in the tumulus, we must suppose that some people had dug into it in search of treasure in the first half of the seventeenth century, and that one of the diggers had dropped his pipe into the hole before it was filled up again. Yet some antiquarians of eminence and name have been nearly betrayed into believing such tobacco-pipes to be Roman, or perhaps even Celtic. Among these are Dr. D. Wilson, who, in his *Archæology of Scotland*, states his conviction that they are of much greater antiquity than the date assigned for the introduction of tobacco into England; and Dr. Bruce, who, in the last edition of his excellent work on the Roman Wall, asks, "Shall we enumerate smoking pipes, such as those shown in the cut, among the articles belonging to the Roman period? Some of them, indeed, have a mediæval aspect, but the fact of their being frequently found in Roman stations, along with pottery and other remains undoubtedly Roman, ought not to be overlooked. The specimens in the cut are one half the size of the original; the larger of these is from the Roman station at Pierce Bridge, the smaller from the north of Northumberland. Some have been recently found at Bremenium." Any one acquainted with the history of the manufacture of these pipes will recognize the two examples given in Dr. Bruce's cut as figures of pipes belonging to the earlier part of the seventeenth century. Similar pipes are described by the Abbé Cochet, in his *Normandie Souterraine*, as found on Roman sites in France, and even that careful antiquary seems to have been almost persuaded of their great antiquity. This circumstance of the occurrence of objects undoubtedly modern in immediate association with others which may be [pronounced with equal confidence to be ancient,

is important in connection with the researches now pursued with so much earnestness among the monuments of the antiquity of man.

One of those curious heaps of the *débris* of the refuse from the tables of our primitive forefathers, which the Danish antiquaries call Köcken-Möddings, and which we might translate by kitchen-middings or kitchen-mixens, has recently been found at Newhaven, in Sussex, and we believe that a full account of it is in preparation, to be read at a future meeting of the Anthropological Society. Among the objects found were limpet and other shell, bones of several animals, a few flint flakes, broken pottery, and two or three rather fragmentary objects of metal. Among the latter are a leaden hook, which appears to have been intended for a fish-hook, and a small coin, but in such a dilapidated condition that it cannot be identified. The pottery appears to be all of the Roman period, and presents several specimens of the dark-coloured ware, made in what some antiquaries have termed smother-kilns, and two fragments of fine Samian ware. The flint flakes were found, as we understand, above the Samian ware. They all belong, probably, to the later Roman period.

The attention of the Society of Antiquaries of Scotland has been called, at a recent meeting, to the existence of artificial islands or crannogs, as they are called, in the Scottish lakes. They are represented as formed by stockading, and intended evidently for places of temporary refuge, and not as permanent residences, in which circumstance chiefly they differ from the pile-buildings of Switzerland. One of these stockaded islands, of which an account was given at a recent meeting of the Scottish Antiquarian Society, is situated in the loch of Dowalton, in Wigtonshire, on the property of Sir William Maxwell; but others were mentioned as having been destroyed within the memory of living people, without any observation of the antiquities which were found in them, and it is believed that many of them yet remain. A short account was also given of a crannog found in a moss near Applegarth, in Dumfriesshire, which consists of a platform of oak-trees resting on moss, and covered by moss of six or seven feet in depth. This foundation platform was covered with layers of brick, twig, and bracken, and, as far as it is at present uncovered, is about a hundred and fifty feet in length by twenty or thirty in width, with the appearance of a hearth at one point. Among the objects found at the Dowalton crannog was a bronze dish of Roman manufacture, which was the only object indicating a date. T. W.

Roman Villa in the Isle of Wight.—A correspondent remarks concerning the Roman villa at Gurnard Bay. "The excavations appear to have been but partially carried out, and without much method; but portions of the limestone walls, the material for which is found on the spot, may be traced. The flooring, also, of one apartment, with its small square red tiling, is exposed in a good state of preservation. From the discolouration of one portion of the stonework, it is presumed the situation of an oven or flue is well determined. The remains stand on what is now the extreme verge of the

cliff, and, from the formation of the latter being alternating beds of clay and limestone, they are rapidly falling in and wasting away; indeed, so much so, that in all probability scarce a vestige of the remains will appear after the usual high tides of the spring."

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

CHEMICAL SOCIETY.—*March* 2.

Action of Silicate of Soda on Cotton.—The injurious action of the soluble glass or mineral sizing used in cotton printing is well known, the strength and durability of the fabric being materially injured by its employment. Dr. Crace Calvert considered that the injury depends on the deposit of liberated silica in the cotton cells, and that the fibre is then weakened by the caustic action of the free alkali. Drs. Frankland and Abel, on the other hand, differed from Dr. Calvert, regarding the inquiry as being of a mechanical rather than a chemical character, and as being due to the expansive force exerted by the carbonate of soda as it crystallizes, after being set free from the silica. The consideration of this subject is an important one, in a domestic as well as a manufacturing point of view, as the employment of the crystallized carbonate of soda used in washing is known to have a very injurious effect on the strength of cotton fabrics washed by its aid, unless it is completely removed by pure water before the process of drying.

GEOLOGICAL SOCIETY.—*March* 8.

The Fossils of Windmill Hill, Gibraltar.—A very interesting communication was received from Mr. Busk and the late Dr. Falconer on the fossils of the Genista Cave of the Rock of Gibraltar. The authors stated that the rock abounds in both seaboard and inland caverns, the Genista Cave being one of the latter class. It has been traced downwards to a depth of 200 feet, but the external aperture has not yet been discovered. It was stated to be full of the remains of quadrupeds and birds, some of the former being now wholly extinct; others, as the *Hyæna brunea*, are now extinct in Europe, and repelled to distant regions of the African continent; while others again live now either on the rock or in the adjoining Spanish peninsula. It was inferred that there had been a connection by land, either circuitous or direct, between Europe and Africa at no very remote geological period. The authors observed that the wild animals whose remains were discovered evidently lived and died upon the rock during a long series of ages.

ROYAL GEOGRAPHICAL SOCIETY.—*March* 13.

On Stereoscopic Maps of Mountainous Countries.—Messrs. Galton described a new application of photography to the delineation of mountainous districts, whereby stereoscopic slides of the ordinary size could be printed for the use of tourists. The best maps fail to impart a correct idea of the inequalities of mountainous regions; this can be done only by models in relief, which are, of course, too cumbersome to be of use in travelling. By taking stereoscopic views of good models (previously coated temporarily with white paint), and giving an index of names of places on the back of each slide, referring to numbers on the stereoscope, all the advantages of a model could be given in a portable form, which could be viewed with a common eye-glass stereoscope, to be carried in the waistcoat pocket. In the case of models representing a large area they could be divided into squares, and separate stereographs taken of each division. This method offers great advantages for the illustrations of guide books of mountainous districts.

MANCHESTER PHILOSOPHICAL SOCIETY.

Development of the Wings of Butterflies and Moths.—An interesting paper was read by Mr. Sidebotham on the great and rapid increase in the size of the wings of Lepidopterous insects immediately after they emerge from the chrysalis. This increase is caused by air, which is taken in through the spiracles or breathing pores, and sent into the vessels of the wings. By this means the membrane is expanded, and the scales which were previously packed under each other as closely as possible are forced to slide out, until they are arranged in the same manner as the scales of a fish or the tiles on a roof. The wing of a moth in an unexpanded state, before it has emerged from the chrysalis, is not folded, but lies perfectly flat; and all the markings can be seen in miniature as indicated by the edges of the scales, which are then alone visible.

PROGRESS OF INVENTION.

Adaptation of Photography to Wood Engraving.—Among the numerous advantages derived from photography, none is of greater importance than the assistance which it affords to the artist. But its uses, in this respect, have been greatly circumscribed by the fact that, hitherto, it has been almost impossible to avoid the necessity of transferring the picture, by the tedious and necessarily imperfect means of the pencil, to the wood on which the designs are to be reproduced. There is no difficulty in obtaining the photograph on the wood itself; but, unfortunately, in doing so, the nitrate of silver employed disorganizes it, and destroys its most valuable properties. A varnish may, it is true, be used to protect the wood; but then it is difficult, if not impossible, for the engraver to perform his part of the process with delicacy and effect. The use of the *Worthley type*,

however, puts an end at once to all these inconveniences. Not only does the uranium-collodion contain so little of the silver salt as to be perfectly harmless; but, when the picture has been obtained, the collodion may be removed, by means of soft cotton dipped in ether, and the image will be found on the surface of the wood as distinct as, and infinitely more perfect than, if it had been produced by the pencil.

A Simple Clock.—Clocks have, long ago, been constructed which were capable of going for a very considerable time with one winding up. But they have been found objectionable, from their great weight, complication, and costliness. A clock was presented to the Society of Natural Sciences, at Versailles, which it is stated will go without winding for a year, or even a longer period, and yet is liable to none of these objections. The only difference between it and an ordinary clock is stated to be, the replacement of the pendulum by a horizontal lever, which is made to oscillate by the torsion of an elastic vertical wire. Varying the dimensions of the lever, varies the rate of oscillation—that which was presented to the Society vibrated once in six seconds.

Self-Acting Apparatus for Steering.—Electro-magnetism has been already applied to purposes so varied and so numerous, that it would be difficult to enumerate them. It has recently been proposed to employ it in the steerage of ships. The idea is both novel and ingenious, and, therefore, deserves attention, although, in its present state, it can hardly be deemed either simple or reliable enough, in practice, to secure the attainment of the object contemplated.

Dr. J. P. Joule proposes to attach to one end of a compound system of needles, or magnetized bars, suspended with great delicacy, a bent wire or commutator, one extremity of which will dip into a central mercury cup, connected with one pole of a galvanic battery, and the other extremity into the one or the other of two concentric semicircular mercury troughs, which are, respectively, in connection with two electro-magnets, and, through their helices, with the other pole of the battery. Which of the electro-magnets will be excited will depend on the position of the ship at the time, with reference to the plane of the magnetic meridian, as on this will depend the mercury trough which, by means of the commutator, will be brought in connection with the central mercury cup. Whichever of the magnets happens to be excited, will attract an armature placed between both of them: and this, by means of levers, will act on valves, so as to cause steam to move a piston in one direction or the opposite, as may be required, until the vessel shall have returned to its proper course. It is obvious, however, that, were no other objection to suggest itself, in practice, the pitching and rolling of the ship must be very likely to seriously interfere with the action of such an apparatus.

Photographic Enamelling.—M. Poitevin, to whom the Academy of Sciences awarded the Trémont Prize, for his discoveries in lithophotography, on the 6th of February last, had advanced, step by

step, until at length he found the method of fixing, on any substance, by means of materials which become hygrometric under the influence of light, carbon, metallic oxides, and other impalpable powders. And the development of this principle led to his discovery that a mixture of tartaric acid and perchloride of iron, which, when acted on by light, becomes hydroscopic, is well suited for fixing metallic oxides on enamelled plates, so as to give the utmost permanency to photographs, by transforming them into enamels. Thus an immense stride in progress was made at once; perishable compounds of silver and gold being replaced by substances of the greatest durability.

A Simplified Pump.—We have already * directed the attention of our readers to one simplification of the common pump; another, which would seem to be still more generally applicable, is coming into use. In the modification already alluded to, the valve in the piston was rendered unnecessary; in that we are about to notice, the piston itself is discarded, The vacuum is obtained by means of a *diaphragm*, which divides the suitably formed chamber of the pump into two compartments. When the diaphragm is moved towards one extremity of the chamber by a rod, one end of which is attached to its centre, the space at the other side is enlarged, a vacuum being formed, and water rushes in through a valve to fill up this vacuum. When the diaphragm is moved by the rod in the opposite direction, the water which has just entered is driven forward in any required direction; a vacuum being at the same time formed at the other side of the diaphragm. The movement of the rod, therefore, in each direction causes both water to enter the chamber to fill up the vacuum, and water to be forced from the opposite side of the chamber. The action is, by consequence, both as to suction and forcing, almost continuous.

Production of a Vacuum by Means of Ammonia.—The emptying of the cesspools in Paris has always been attended with great inconvenience. Among the methods proposed for obviating this, has been the use of air-tight tanks as carts, the causing a vacuum within them by pumping out the atmospheric air, and then filling them, when arrived at the cesspool, by atmospheric pressure. In theory this method was excellent, in practice it was found impossible to maintain the vacuum for the required length of time. M. Tellier, who suggested liquified ammonia as a source of motive power,† considers that gaseous ammonia may be used for the production of a vacuum in these tanks. For this purpose, he would have at the establishment whence the carts are to be despatched, a boiler containing water of ammonia. From this, gaseous ammonia is to be liberated by heat, and transmitted to the tank in which it is intended to form the vacuum. The atmospheric air is thus driven from the interior of the tank; and any ammonia that may pass off along with it is to be retained by water, through which the mixture is passed for the purpose. Ammonia is allowed to enter the tank,

* Intellectual Observer, No. xxxvii. p. 78.
† Intellectual Observer, No. xxxviii. p. 148.

until the pressure within it very slightly exceeds that of the external atmosphere; there will then be little tendency to leakage, but if a leak should exist, it will be readily detected and stopped. When the tank arrives at its destination, it is to be put in connection with the receptacle to be emptied, and at the same time with a small quantity of water properly situated for the purpose. The ammonia is, of course, instantly condensed, a vacuum is formed, and the tank is filled by atmospheric pressure, The water used for condensing the ammonia may be transferred to the boiler already mentioned, so that nothing will be wasted.

Regulation of Temperature by means of a Self-Acting Thermometer.—A thermometer intended for this purpose has been invented by General Morin. It is simple and effective; it would seem to be applicable to the prevention of either too high or too low a temperature; and even, by a further development of the principle, to be capable of lowering the temperature by a ventilating apparatus it might set in action; or raising it, by producing a required modification in the supply of heat.

To construct this thermometer, a piece of platinum foil is hermetically fixed in the bulb of the instrument, and another in the stem just at the point to which the mercury will reach, when the temperature is exactly what it should be. These slips of platinum are to be connected with the poles of a galvanic battery, the helix of an electro-magnet forming part of the circuit. When the mercury sinks too low in the stem of the thermometer, battery connection is broken, the electro-magnet loses its excitement, and an armature, which it had previously continued to support, immediately falls. This completes an electric circuit, setting in motion a current which throws a loud alarm into action, and continues to sound its bell until the proper temperature has been reproduced.

A New Caloric Engine.—A new kind of caloric engine has been lately invented in Germany. Its chief peculiarity consists in air being forced for the support of combustion into an air-tight furnace, within which is placed a fireplace of refractory clay. The products of combustion, mixed with a little steam, which is intended principally to furnish a kind of lubrication for the reciprocating portions in contact with it, give motion to two pistons of peculiar construction, after which they escape into the atmosphere. The combustion produced in this way is very energetic, being, it is said, sufficient, when a pressure of about four atmospheres is employed, to fuse malleable iron. Increase of velocity produces an immediate increase in the intensity of combustion; and this increase of intensity reacts at once on the velocity, so that there is a great tendency in this engine to a very rapid motion—which in many cases is a great advantage. It is asserted that, with this arrangement, a much greater calorific effect is obtained from a given amount of fuel than in the ordinary way.

Miscellaneous.—*Improved Bunsen Battery.*—The vapours evolved by the ordinary Bunsen battery are very prejudicial to health. M. Emile Duchemin gets rid of them without a loss of

power, by replacing the nitric acid with an aqueous solution of perchloride of iron. He found that substituting a solution of chloride of sodium for sulphuric acid, left the battery still very effective, and that even if the zinc is surrounded with pure water the battery is well suited for telegraphy.——*Antozone.*—The existence of this substance has been the subject of serious doubt. Schönbein has, however, obtained it, by means of a powerful galvanic battery. He found its specific gravity less than that of hydrogen; it is, therefore, the lightest substance known. It is liquified by a pressure of 150 atmospheres. Mixed with ozone, it is exploded by the non-luminous rays of the spectrum, and by positive, but not by negative electricity. If this latter fact shall have been established by further experiments, it will afford a seemingly unanswerable proof of the existence of *two* electricities.——*New Mode of Softening Photographs.*—M. Mathey, for this purpose, interposes a lace veil between the sitter and the camera—the nearer the latter, the more useful it is. It produces the effect of a drawing in chalks; and softens down prominent characteristics in the model which would impart harshness to the picture.——*New Mode of Silvering Mirrors.*—Two-thirds of an ounce of platinum are dissolved, with the aid of heat, in two ounces and a-half of hydrochloric acid and one ounce and a-sixteenth of nitric acid. The solution is next evaporated, and the residue is pulverized and dissolved in alcohol. The alcoholic solution is applied to the glass, which is then heated to a cherry red, and afterwards cautiously cooled. An excellent, a very durable, and a cheap reflecting surface is thus obtained.——*Application of the Magnesium Light to Medicine.*—The laryngoscope is an instrument consisting of two mirrors, and is used for inspection of the throat, etc. It has been rendered much more effective by employing for its illumination the light of burning magnesium. The rays from the ignited metal are thrown on the mirror situated at the end of the throat, and projected downwards, so as brilliantly to illuminate the larynx and trachea, and form their image in the other mirror. The minute image thus obtained is greatly magnified, by means of a double convex lens, which is held in front of the patient's mouth; and the smallest symptoms of disease in the respiratory passages are rendered distinctly visible.——*Improvement of the Jaquard Loom.*—The necessity for cumbersome and expensive cards has always been found a source of great inconvenience with this loom; but they have been, at length, rendered unnecessary by M. Acklin, a French engineer, who has substituted for them punched paper, which saves about one-third of the cost, renders lacing—a tedious process—unnecessary, and economizes both labour and time, while it enables the work to be executed more perfectly. The invention is applicable to looms already in use.

NOTES AND MEMORANDA.

The Flowing of Ice and other Solids under great Pressure.—M. Tresca made a second communication to the Academy of Sciences of Paris at a recent sitting, on this very interesting subject. An account of his first paper was given in our Vol. vi., p. 464. He uses a strong cylinder, almost six inches in diameter, and having at its lower end an aperture about two inches in diameter. The more nearly the diameter of the opening approaches that of the cylinder in size, the less the pressure which will be required. To render perceptible the modifications which the bounding surfaces of the different portions of the ice would undergo during their passage through the cylinder and aperture, portions of it were either coloured throughout their masses, or on those faces which constituted the joints. It was found that the ice comported itself in exactly the same way as lead and ceramic pastes had done in the previous experiments, which we have already described. But while a pressure of about 1792 lbs. per square inch, or that of a column of water about 4000 feet high, was sufficient to cause the flowing of the ice, lead had for the same purpose required a pressure of about 9000 lbs., or that of a column of water nearly 20,000 feet high. The effects produced were very remarkable. The surfaces of the joints, originally plain, were changed into concentric tubes, and the ice as it issued from the aperture in the cylinder was furrowed by transverse fissures, so as to resemble a series of discs rather than a continuous solid. This peculiarity had been observed also with the less flexible porcelain pastes. It was apparently dependent on the nature of the material used, and was evidently a secondary phenomenon, which took place after the flowing had happened, and while the ice was actually within the aperture of the cylinder, being due to the cessation of pressure. Each disc consisted of many concentric layers, which must have been produced before the separation into discs occurred. These experiments were believed to throw considerable light on the theory of the movement of glaciers. Superimposed layers were displaced, surfaces were distorted, layers were curved at the extremities of the partial tubes, fissures were produced when pressure ceased, etc., just as in the case of the glaciers. It was remarked that although the ice lost its original form, it did not lose its transparency under the influence of pressure.

Dissociation of Sulphurous Acid.—M. H. Deville, as explained in an article, Vol. iii., p. 191, to which the reader is referred for a description of the apparatus, applies this term to the separation of the constituents of a compound, at a temperature lower than that which would cause complete decomposition. Sulphurous acid transmitted between the tubes he employs, the outer one being at 2192° Fahr., and the inner, which was of plated copper, about 50° Fahr., was decomposed, sulphur being deposited on the silver, but not combining with it; and sulphuric acid being formed with the oxygen, liberated and undecomposed sulphurous acid.

Age at which the Moon can be Seen.—A subscriber at Runcorn remarks on this subject that he saw the moon on the 8th of February, 1864, when it was little more than 23 hours old. On another occasion he saw it when 43 hours 40 minutes old, and persons to whom he pointed it out said it was the narrowest moon they had ever seen. It is obvious that the early visibility of our satellite will depend upon her latitude at the time, and upon the state of the atmosphere. Mr. Webb obligingly informs us that "Hevelius never saw the moon earlier than 40 hours after conjunction with the sun; and Schröter's nearest points were about 28½ hours on either side. Beer and Mädler saw it 18h. before conjunction, 1834, October 1, when the moon was 11° distant from the sun, and almost vertically over it, 8° 36′ above the horizon." Jews and Mahomedans are likely upon religious grounds to watch for the earliest appearance of a new moon, and it would be interesting to know what their experience has been.

Action of Venus on the Sun.—In the Intellectual Observer, Vol. v., p. 448, we published a very important paper, by Mr. Balfour Stewart, "On the Origin of the Light of the Sun and Stars," and since that date we have mentioned the further researches of that careful observer. We now find in the *Pro-*

ceedings of the Royal Society a paper detailing additional facts, which tend to show that an external influence operates on the production and behaviour of sun spots. All the planets might act in this way with a force proportioned to their masses and distances, Mercury, Venus, and Jupiter being presumed the most influential, the first from proximity, the second from being both near and tolerably large, and the third from its great size. The question to be resolved is whether the spots break out, increase and decrease in any regular manner, corresponding with the relative positions of planets and the sun. An examination of thirty-two series of spots shows that their behaviour seems to be connected with the positions of Venus "in such a manner that spots dissolve when that part of the sun's surface in which they exist approaches the neighbourhood of this planet, while, on the other hand, as the sun's disc recedes from the planet, spots begin to break out, and reach their maximum on the opposite side."

Diffusion of Crystallized Substances through the Body.—Dr. Bence Jones calls the attention of the Royal Society to facts of this class ascertained by spectrum analysis. He found that if half a grain of lithium was given to a guinea pig for three successive days, it could be detected in every texture of the body.

Insect Metallurgists.—*Cosmos* describes an article by Dr. Sjogreen, a Swedish naturalist, in which it is stated that the particles of pure iron found in Swedish lakes result from the deoxydizing action of certain insects. Their larvæ are stated to absorb oxygen from the oxydes of iron, and to give themselves a coating of the pure metal, which acts like a cocoon, and protects them during metamorphosis.

Report on Spontaneous Generation.—Our readers will recollect that the French Academy appointed a commission to witness and report upon the experiments and counter-experiments of Messrs. Pasteur, Pouchet, etc., on this subject. The experiments hitherto made and reported upon confirm the statements of M. Pasteur that if due pains are taken to destroy existing germs in a fermentible liquid, and to prevent the access of fresh germs, no life is manifested. The liquid used by M. Pasteur was obtained by washing yeast from beer. Other experiments are to be made with infusions of hay during the approaching spring and summer.

Modified Sulphur.—In a former number we mentioned that a modification of sulphur could be produced by fusing it with a little iodine. Messrs. Moutier and Dietzenbach have laid further remarks on this subject before the French Academy. One four hundredth part of iodine changes the sulphur, so that on cooling it remains plastic, and is only partly soluble in sulphide of carbon. Napthaline, paraffine, creosote, camphor, and spirit of turpentine, mingled with sulphur to the extent of one four hundredth or one six hundredth, permit it to cool in a soft ductile state, which passes slowly into the usual hard brittle condition. Oil and wax make the sulphur soft, but leave it entirely soluble in sulphide of carbon. The experimenters have ascertained that the carbon particles effect the change in these cases.

Bond's Discovery in the Orion Nebula.—We learn from the address of the President of the Astronomical Society, as given in *Monthly Notices*, that Professor G. V. Bond, to whom the Society's gold medal was awarded just before his lamented death on the 17th February, discovered "a great re-entering loop of nebulous matter, extending around nearly the whole of the previously known portion, and enclosing as with a nebulous wall a large space exterior to the well-known figure. It was discovered by employing with the 22-feet refractor of 15 inches aperture, an eye-piece magnifying 90 times with a field of 30′."

Abnormal Memory.—The last illness of Friedrich Struve, the late Director of the Poulkowa Observatory, was characterized by a not unusual, but very interesting condition of the memory, which is thus alluded to in the biographical memoir to be found in the *Monthly Notices* :—" When he began to recover from the exhaustion occasioned by the first attack of his malady, his memory, for all events of recent occurrence, wholly failed him, while at the same time it exhibited its usual, or even increased tenacity in things long passed away. On such occasions, he would seem to be living wholly in the scenes of the past, reciting pas-

sages in Greek, Latin, or Hebrew, and speaking in some of the many dialects in which he had learnt to converse in his youth. In the midst, however, of this vivid resuscitation of the past, co-existing with the temporary oblivion of all recent associations, it is a touchingly suggestive circumstance that he never forgot the face of a friend."

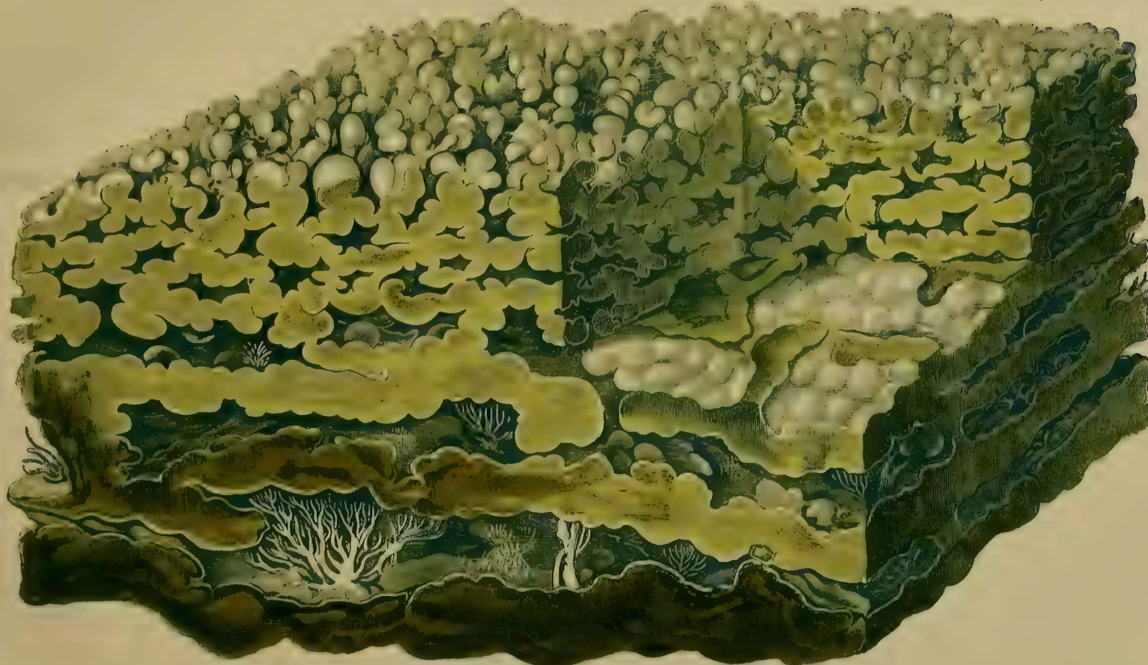
Diffraction Experiments.—Mr. Bridge informs us, with reference to his apparatus described in our last number, that if the object-glass is removed, and the point of light viewed with the telescope out of focus, a new series of appearances may be obtained, and that by moving the object-glass to and fro to different distances from the eye-glass, a new form of figure is given by each position. Many of the spectra Mr. Bridge considers would offer valuable suggestions to designers of glass windows, carpets, etc.

Microscope Lamp.—Mr. John Bockett sends us a photograph of his method of mounting and using a microscope lamp. A pillar upon a foot carries a glass lamp with a reflector behind it, and a condensing lens in front. The reflector is about 3½-inches in diameter, and the bull's-eye condenser about 2 inches diameter, and placed a little within the focus of the reflector. A shade is also provided. We have long used and recommended the addition of a silvered reflector behind a lamp. It not only economizes light, but for many purposes improves its quality, as objects may be illuminated almost entirely by the reflected light when the wick is turned low, and thus the glare of the direct flame is avoided. Mr. Bockett burns Belmontine, which gives a whiter light than paraffine.

Properties of Muscular Tissue.—Dr. William Marcet has communicated to the Physical and Natural History Society of Geneva, a paper on the physical properties of muscular tissue. He finds that it is a porous body, and feebly participates in the properties of colloid substances. Its porosity allows it to be traversed by solutions of albumen, which, however, only proceed through it at half the rate of solution of phosphoric acid, thus showing that, like colloid bodies, it opposes a certain obstacle to the transfusion of other colloids, and facilitates the passage of crystalloids. Those to whom these terms are new should read the paper on "Dialysis," Vol. i., p. 381. Physiologists will perceive the relation which Dr. Marcet's researches bear to the question of the nutrition of muscles. Dr. Marcet's paper appears in the *Archives des Sciences*, No. 86.

Simplified Opthalmoscope.—Messrs. Smith, Beck, and Beck have introduced a simplification of Liebreich's Opthalmoscope, which renders this instrument suitable for general use. The optical part is arranged in a single tube, which carries both the mirror and the magnifying lens. The apparatus can be adjusted to any height, and is fitted with a moveable arm, at the extremity of which is a small lamp, furnished with a screen to keep the light off the face of the individual under examination. A rest for the chin is also provided, and the whole packs into a small case.

Fossil Equisetum in Gneiss.—M. Elie de Beaumont lately presented to the French Academy a paper by M. A. Sismonda, on a block of gneiss, in the Turin Museum, bearing the impress of a plant, which M. Adolphe Brongniart states is allied to the *Equisetum infundibuliforme* of the coal measures. He proposes to name it *Equisetum Sismondæ*. The block of gneiss appears to have been an erratic from the Valtelline, and belonging to the *infra Liassic* group, which form the general substratum of Alpine sedimentary rocks. At first M. Sismonda thought the markings of a dendritic mineral character, but experiment and observation showed them to be carbonaceous. The discovery of this fossil shows the metamorphic character of the Alpine gneiss.



Eozoön Canadense.

THE INTELLECTUAL OBSERVER.

MAY, 1865.

DERVISHES AND HADJIS.

BY ARMINIUS VÁMBÉRY.

The Dervish is the veritable personification of Eastern life. Idleness, fanaticism, and slovenliness are the features which in him are regarded as virtues, and which everywhere are represented by him as such. Idleness is excused by allusion to human impotence, fanaticism explained as enthusiasm in religion, and slovenliness justified by the uselessness of poor mortals to struggle against fate. If the superiority of European civilization over that of the East was not so clearly established, I should almost be tempted to envy a dervish, who, clad in tatters and cowering in a corner of some ruined building, shows by the twinkle in his eye the happiness he enjoys. What a serenity is depicted in that face; what a placidity in all his actions; what a complete contrast there is between this picture and that presented by our European civilization! In my disguise as a dervish, it was chiefly this unnatural composure which made me nervous, and in the imitation of which I made of course the greatest mistakes. I shall never forget one day at Herat, when, after reflecting on the happiness of the early termination of the painful mask I had been wearing for so many months, I suddenly jumped up from my seat, and in a somewhat excited state began to pace up and down the old ruin which gave me shelter. A few minutes afterwards I perceived that a crowd of passers-by had collected at the door, and that I was the object of general astonishment. Seeing my mistake, I blushingly resumed my seat. Soon afterwards, several people came up to ask me what was the matter with me, whether I was well, etc. The good people thought I was deranged, for to oriental notions a man must be out of his senses if, without necessity or a special object in view, he suddenly leaves his seat to pace up and down a room.

As the dervish represents the general character, so he does

the different peoples of the East. It is true, Mahommedanism enforces the dogma, "All the true believers are brethren;" but the origin and home of the different sects are easily recognized. Bektashi, Mevlevi, and Rufai are principally natives of Turkey, because Bektash, the enthusiastic founder of the Janissaries, Molla Djelaleddin Rumi, the great poet of the Mesnevi, lived and are buried in Turkey; the Kadrie and Djelali are most frequently met with in Arabia, the Oveisi, and Nurbakhchi Nimetullahi in Persia, the Khilali and Zahibi in India, and the Nakishbendi and Sofi Islam* in Central Asia. The members of the different fraternities are bound together by very close ties; apprentices (Murid) and assistants (Khalfa) have to yield implicit obedience to the chief (Pir), who has an unlimited power over the life and property of his brethren. But these fraternities do not in the least trouble themselves about secret political or social objects, as is sometimes asserted in Europe by enthusiastic travellers, who have even discovered freemasons amongst the Bedouin tribes of the Great Desert. The dervishes are the monks of Islamism; and the spirit which created and sustains them is that of religious fanaticism, and they differ from each other only by the manner in which they demonstrate their enthusiasm. For instance, whilst one of these religious orders commands constant pilgrimages to the tombs of saints, the other lays down stringent rules for reflection on divine infinity and the insignificance of our existence. A third compels his votaries to occupy themselves day and night with repeating the name of God (Zikr), and hymns (Telkin); and it cannot surprise us to learn that the greater number of a company which has continually been calling out with all its might "Ja hu! Ja hakk! La illahi illahu!" are seized with *delirium tremens*. The orthodox call this condition Medjzub; *i. e.*, carried away by divine love, or to be in ecstasy. A person to whom such a fortunate event happens, for as such it is regarded, is envied by everybody; and as long as it lasts, the sick and the maimed and barren women try to get in his immediate presence, taking hold of his dress, as touching it is supposed to have healing power.

What the dervishes are able to do during the ecstasy caused by *Zikr*, I had once an opportunity of witnessing in Samarkand. In Dehbid, close to the tomb of the Makhdun Aazaram, one of these howling companies had grouped themselves around the Pir (chief) of that district. At first they contented them-

* Sofi Islam is a sect which originated about thirty years ago. Its founder, a Tadjik, from Belkh, was desirous of opposing the ever-increasing influence of the Nakishbendi. In this fraternity prevails the principle of communism and blood relationship. The Sofi Islamites wear a cap trimmed with fur, and are most frequently met with this side of the Oxus, as far as Herat, and also amongst the Turkomans.

selves with repeating the formula in a natural tone of voice, and almost in measured time. The chief was lost in the deepest thought, all eyes and ears were fixed upon him, and every motion of his hand and every breath he drew was audible, and encouraged his followers to utter wilder and louder ejaculations. At last he seemed to awake from his sleep-like reflections, and as soon as he raised his head all the dervishes jumped up from their seats like possessed beings. The circle was broken, and the different members began to dance in undulating motions; but hardly did the chief stand upon his feet than the enthusiastic dancers became so terribly excited that I, who had to imitate all their wild antics, became almost frightened. They were flying about, constantly dancing, right and left, hither and thither, some leaving the soft meadow and getting upon the rough stones, constantly dancing, till the blood began to run freely from their feet, still they kept on their mad excitement, till most of them fell fainting to the ground.

It is the same with dervishism as with all the other oriental institutions, customs, and manners; the more we penetrate towards the East, the greater is the purity with which they have been preserved. In Persia the dervishes play a much more important part than in Turkey; and in Central Asia, isolated as it has been from the rest of the world for centuries, this fraternity is still in full vigour, and exercises a great influence upon society. In my *Travels* I have frequently alluded to the position occupied by the *Ischan*, or secular priests, in Central Asia. Their influence may be called a fortunate one contrasted with the fearful tyranny existing in those countries. This is the reason why every one occupies himself with religion; every one tries to pass himself off as a worker of miracles (Ehli Keramet), or if he fails in that, he endeavours to be recognized as a saint (Veli Ullah). Those who make the interpretation of the sacred writings their business, are great rivals of the *Ischans*, who by the mysticism by which they surround themselves, enjoy a large share of popular esteem. The native of Central Asia, like the wildest child of Arabia, is more easily imposed upon by magic formulas and similar hocus-pocus than by books. He may dispense with the services of a Mollah, but he cannot do without a Ischan, whose blessing (*fatika*) or breath (*hafesi*) is required when he sets out on one of his predatory expeditions, and upon which he looks as a talismanic power, when moving about his herds, his tent, or the wilds of the desert.

After the Ischanes, the most interesting class are the mendicant dervishes (Kalenter*), which the Kirguese and Turko-

* Kalentor is a corruption of the old Persian Kelantor, *i. e.*, the more powerful. In Eastern Persia the title is still given to the judges of villages.

mans call Kudush* or Divane (insane). In the whole of the great deserts which stretch from the eastern boundaries of China to the Caspian Sea, it is only these people, in their ragged dress, who are able to move unmolested. They do not take any notice of the differences of tribe or family, and the mighty words *Jaghi* or *Il* (friend or enemy) have to them no meaning. In travelling along they join whomsoever they meet, be it a peaceful caravan or band of *robbers*. The dervishes who travel through Kirguese or Turkoman steppes are generally this class of people, who from a strong inclination to do nothing, follow a trade which, throughout the East, is considered respectable, viz., that of a mendicant. All they have to acquire is a few prayers and a certain power of mimicry, with which the chiromantic feats are performed, and I have never seen a nomad who has not been moved when he found himself in the close presence of one of those long-haired, bare-headed, and barefooted dervishes, who with his fiery eyes, stared hard at the son of the desert, and whilst shaking his Keshkul† howled a wild *"Ja hu!"*

The arrival of one of these fakirs in a lonely group of tents is regarded as a joyful event, or almost a festival; it is of especial importance in the eyes of the women; and the time of his arrival is differently interpreted. Early in the morning signifies the happy birth of a camel, or a horse; at noon a quarrel between husband and wife; and in the evening a good prospect of marriage to the marriageable daughters. The dervish is generally taken in hand by the women, and is well supplied with the best things the tent contains, in hopes that he may be tempted to produce from beneath his battered dress some glass beads, or other talisman. Alms, which amongst the nomads seldom consist of money, are rarely denied him; and he often receives an old carpet, a few handfuls of camel hair or wool, or an old garment. He may also stop with the family for days, and move about with it without his presence becoming a burden. If the dervish possesses musical talent, *i. e.*, able to sing a few songs and accompany himself on the two-stringed instrument called Dutara, he is made much of, and has the greatest difficulty in getting away from the hospitable host.

It is very seldom that dervishes are insulted or ill-treated; this, however, is said to be the case amongst the Turkoman, whose rapacity knows no bounds, and prompts them to commit incredible acts of cruelty. A dervish, from Bokhara, of

* Kuddus (Hungarian: Kódus, *i. e.*, beggar), is derived from Kudurmak, to become mad; thus the Arabs call the dervishes "Medjnun," *i. e.*, insane.

† Keshkul is a vessel formed of half a cocoa-nut, the *vade mecum* of the dervishes, in which he plunges all the food he has collected by begging, whether dry or fluid, sweet or sour. Such a dish of *tutti frutti* would but ill suit our gastronomers, and yet how delicious it tasted to me after a long day's march.

robust figure and dark curly hair, whom I met at Maymene, told me that a Tekke Turkoman, prompted by the thirty ducats which his athletic figure promised to fetch in the slave market, made him a prisoner, to sell him a few days afterwards. "I pretended," my colleague continued, "to be quite unconcerned, and repeated the *Zikr* and *Tesbih*, whilst shaking my iron chains. The time was fast approaching when I was to be taken to the market, when suddenly the wife of the robber of my liberty and person was taken ill, and prevented him from starting. He seemed to see in this the finger of God, and began to be pensive, when his favourite horse, refusing to eat his food, showed signs of illness." This was enough. The robber was so frightened that he removed the chains of his prisoner, and returned to him the things he had robbed him of, begging him to leave his tent as soon as possible. Whilst the Turkoman impatiently awaited the departure of the ominous beggar, the latter fumbled about his dress, and pretended that he had lost a comb, which his chief had given him as a talisman on the road, and without which he could not go a single step. The nomad returned in great haste to the place where the plunder had been kept, and as the comb did not turn up he became still more frightened, and promised the dervish the price of twenty combs if he would only take a single step beyond the boundary of his tent. The cunning Bokhariat saw he was master of the situation; he pretended to be inconsolable about the lost property, which he kept in his pocket, and did not lose at all, and declared that he now would have to remain for years in the tent. Imagine the confusion of the deceived and superstitious robber! Like a madman, he ran about asking his neighbour for advice. Formal negotiations were now commenced with the dervish, to whom, finally, a horse, a dress, and ten ducats were presented, to make up for the loss of the comb, and on condition that he should leave a tent, whose proprietor will probably think twice before he ventures again upon molesting a travelling dervish.

Besides the dervishes, who, as physicians, miracle-working saints, or aimless vagabonds, are wandering about in Central Asia, there is a class called *Khanka neshin*, or convent dwellers, who always wish to appear as the poorest, and are, without doubt, the most contemptible fellows in the world. Generally speaking, they are opium eaters, who by their excessive filth, skeleton-like body, and frightfully distorted features, present a most repulsive appearance. The worst is that they do not confine themselves to practising this fearful vice themselves, but, with a singular persistency, endeavour to make converts amongst all classes, and, supported by the want of

spirituous drinks, they succeed but too frequently in their wicked attempts. What surprised me most was that these wretched people were regarded as eminently religious, of whom it was thought that, from their love to God and the Prophet, they had become mad, and stupefied themselves in order that in their excited state they might be nearer the beings whom they loved so well.

Speaking of dervishes, we may mention a class of hypocrites, who, under the pretence of carrying out sacred vows, indulge in their desire to travel, and after their return assume, under the title of Hadji Pilgrims, authority and a good social position. The Koran says: "*Hidju ala beïti min isti-taatun Sebila*"—"Wander to my house (*Kaaba*) if circumstances permit." These "circumstances" are reduced to the following seven conditions by the commentators:—The pilgrimage must be undertaken with, 1st, sufficient money for travelling expenses; 2nd, bodily health; 3rd, in an unmarried state; 4th, without leaving debts behind; 5th, in times of peace; 6th, overland and without danger; and, 7th, and by persons who have reached the age of puberty. That our good Tartars ill observe these conditions will be evident to all who have some idea about the countries situated between Oxus and Taxartus. In Persia people go to Kerbela, Meshed, or Mekka, only when sufficient funds enable them to do it comfortably. In Central Asia, on the contrary, it is always the poorest class who undertake pilgrimages. A certain taste for adventure, coupled with religious enthusiasm, are the two motives which prompt the inhabitants of Central Asia to start from the remote East for the tomb of their Prophet. True, they do not suffer any material losses, for a beggar's bag is a money-bag; but they frequently lose what is most precious to them—their life—as every year at least one-third of the pilgrims from Turkistan die from exposure to the climate.

This sacred, or profane, desire to travel, braves all danger; this vague thought of tearing himself away from his family, and friends, and countrymen, to see the wide world, surrounds the hadjis with a certain poetry. I have lived weeks with my companions, and yet it always interested me to behold them, palm-staff in hand, as a sacred memento of Arabia, vigorously making their way over the deep sand or mud. They were returning happily to their homes; but how many did I meet who had only commenced their long and tedious journey, and yet they were equally happy. On my road from Samarkand to Teheran I had as a companion a native of Chinese Tartary, who, in total ignorance of the route he had to take, asked me every evening, even when we were yet at Meshed, whether we should see to-morrow, or at the farthest after to-morrow,

the minarets of Mekka? The poor fellow had no idea how much he would have to endure before he reached his destination. However, this should not surprise us, when we remember that during the time of the Crusades so many honest Teutons undertook a pilgrimage to the Holy Land, and after two or three days' journey hoped to behold the walls of Jerusalem.*

The routes to Arabia adopted by the pious Tartars are the following, viz., 1, Yarkend, Kilian, Tibet, Kashmir;† 2, through Southern Siberia, Karyan, and Constantinople; 3, through Afghanistan and India to Djedda; 1, through Persia, Bagdad, and Damascus. None of these routes is a comfortable one, and the amount of danger to be incurred is very much dependant upon the season of the year and the political state of the countries through which they pass. The travellers form themselves in larger or smaller companies, and elect a chief (*Chaush*) from amongst themselves, who also fills amongst them the office of *Imam* (the person who first says the prayers to be repeated by the rest), and who enjoys a considerable superiority over his companions. A visit to the Kaaba and the tomb of the Prophet (which may be paid at any season) is not so much the culminating point of the whole pilgrimage as the ascent of Mount Arafat. This can be made only once a year, viz., on the Kurban festival (10th Zil, Hidji), which is nothing more or less than the sacrifice of Abraham and Isaac dramatised. All those who have taken part in this festival, and have joined in the cry, "Lebeik, Allah!" (Command, oh God)—in allusion to Abraham's implicit obedience—are regarded as genuine hadjis. This cry of "Lebeik! lebeik!" uttered at the most solemn moment of the whole pilgrimage, seems also to have the deepest impression upon the pilgrim himself. My travelling companions, whenever they became excited, or were in a happy mood of mind, always alluded to it; and the stillness of the Tartaric deserts was often broken by this memento of the stony districts of Arabia.

However painful and heartrending separation from home may be when so long and dangerous a journey has to be undertaken, the joy which the hadjis experienced on their return fully counterbalances it. Friends and relations, informed of their near arrival, go out to meet them several days in advance. Hymns are sung, and tears of joy are shed when the hadji makes his entry into his native place. Every one wants to embrace him, to touch him, for the atmosphere of

* See Nösselt's Geschichte für Töchter schulen I., who also states that many pilgrims, ignorant of the road, allowed themselves to be led by a frightened goose which ran before them.

† From Yarkend (Jarkend) to Kilian, on the boundary line, are three days' journey; from there by way of Tagarma and Kadun to Thibet, twenty days; and thence to Kashmir, fifteen days.

holy places still surrounds him, the dust of Mekka and Medina still covers his garments. In Central Asia the hadji is held in much greater esteem than in any other Mohammedan country. It has cost him much to obtain his dignity, but he is amply repaid. Respected and supported by his fellow-citizens, he is better protected against the tyranny of the government than any other citizen. The title of a "*hadji*" is a patent of nobility, which during his lifetime he parades on his seal, after death on his tombstone.

The hadjis—of course such as are not mere beggars—often transact, during their pious pilgrimage, a little commercial business. "*Hem tidjaret hen ziaret,*" "commerce and pilgrimage together," are not allowed by their religion; but nobody seems to suffer any pricks of conscience in taking to his co-religionist in Arabia a few articles from distant Turkomania. The products of Bokhara, and other holy places of Central Asia, are in high esteem amongst the people of Arabia; besides, every one wishes to show a hadji some favour, and is easily induced to pay double the value for any article offered. This small trade is carried on between the easternmost point of Islamitic Asia to the Galata bridge of Constantinople. Amongst the crowd of that famous capital one often sees a Tartar whose features contrast as strangely with the rest of the population as the colours of the thin silk kerchief differ from those of an European manufacture. Fine ladies seldom become purchasers of such articles, but old matrons are frequently seen, inspired by feelings of piety, paying a good price for them, pressing them repeatedly to their face and forehead while repeating a loud "*Allahumu Sella,*" and continuing their walk.

That the successful sale of the exported articles leads to the importation of similar merchandise, needs no confirmation. No hadji leaves the holy places without making some purchases. At Mekka he lays in a stock of scents, dates, rosaries, and combs, but especially water from the sacred well, called Zem Zem.* In Yambu and Djidda are bought European goods; these go by the name of Mali Istambul, *i.e.*, Stamboul goods, as the unbelieving Franks must not obtain credit for anything, and they consist of penknives, scissors, needles, thimbles, etc. Aleppo and Damascus enjoy the reputation of supplying the best Misvak, a fibrous root, used as tooth-brushes by all pious Moslems. In Bagdad are bought a Hirkia, made of camel's hair, and of superior quality at this

* Zem zem is the name of a famous well on the road, of miraculous power, the water of which is exported in small vessels to all Islamite countries, as a single drop of it, taken just at the moment of death, frees from five hundred years of purgatory. The origin of the well is ascribed to Ismail, who, after being left behind by Hagar, stamped his little foot, and made the well spring up.

place, as it is this kind of garment which the Prophet is said to have worn next his skin. Finally, in Persia, ink powder, and pens, made of canes, are purchased. In Central Asia all these articles are great curiosities, and they are paid for handsomely, partly from necessity, partly from religious motives.

Generally speaking, a caravan of hadjis, I mean one whose character has been well inquired into, are the best travelling companions one can have in Central Asia, or rather in the whole of the East, provided one can manage to agree with them. With regard to the travelling necessaries, the hadji is well supplied, and it was always surprising to me to see how a man, who had only one poor donkey he could call his own, could make a display of a separate tea-service* (*à la Tartar*), pilou apparatus, and carpet, when arrived at the station at which we halted. Nobody is more clever than a hadji in negotiating, be the people he has to deal with believers or unbelievers, nomades or agricultural tribes. A hadji may be converted into anything, he being thoroughly penetrated by the principle, "*Si fueris Romæ.*" Instead of being cast down and gloomy, as his ragged exterior would lead us to suppose, he is of a merry disposition, and, during the long marches, the greatest saint and miracle-maker occasionally indulges in a profane joke. The comicality of these generally serious faces has often made me forget the privations which I was myself undergoing.

* The tea-service consists of a can-like vessel made of copper, and is, next to the Koran, the most indispensable *vade mecum* of every travelling Tartar. Even the poorest beggar carries it, suspended by the handle, about with him.

GOLD CURRENCY IN INDIA.

BY JOSEPH NEWTON.

The recent introduction, under warrant of Government, of a gold currency throughout the three Presidencies of British India, is an event of sufficient importance to justify some remark. The innovation is one which must create considerable excitement among the native inhabitants, who have always entertained a very strong prejudice in favour of silver money. That that excitement will be of short duration, and that the prejudice will soon die a natural death, may be foretold without much prescience, and without a shadow of a chance of the non-fulfilment of the prophecy.

The advantages likely to arise from the existence of a gold coinage in India had indeed forced themselves upon the attention of such of the wealthy and more intelligent natives as were engaged in the transactions of commerce, long before the order in council legalized its use in our Indian possessions. The Government, therefore, in admitting gold coins to a legal position, have only recognized actual facts, and inaugurated a financial reformation which growing commerce and enlarged experience had proved to be not only expedient but absolutely necessary. It is not a theoretical crotchet, but the enlightened recognition of a want and the application of a means of supplying it. The change would probably have been effected at an earlier date, but for the circumstance that the coined sovereign and half-sovereign do not exactly tally with any combination of silver coins circulating in India. The alternatives presented for overcoming this inconvenience were to disregard the relative difference of value between the rupee and the sovereign, or else to remodel the silver coinage of that country, and make it harmonize in its divisions with our own gold currency. In the latter case the serious evil would have had to be encountered of inciting much popular discontent, if not of something worse, and therefore the idea was necessarily abandoned. It remained to adopt the former, or to leave things as they were. Thanks principally to Sir Charles Trevelyan, the late financial secretary to the Government of Bengal, the determination was arrived at to make the sovereign and the half-sovereign current at the value of ten and five rupees respectively, and thus to confer, apparently, a favour upon the present holders of silver money.

The legalization of a gold currency throughout the Presidencies cannot be construed, by any perversity of reasoning or ingenuity of argument, into an arbitrary interference with the

native coin, so to speak, but must be regarded as a superaddition to it, rendered imperative by the extension of trade and traffic, and one which will facilitate largely the prosecution of both. It is not impossible that in the fulness of time, when the native population shall have become familiar with the gold coins of Great Britain, and can appreciate their portability, the sovereign may become the unit of commercial calculation in India as it is at home. Thus the way would be paved for the introduction of English silver coins as well. Such a consummation, however, if it be attained at all, must be arrived at by natural, and not artificial means, and cannot be forced.

A perfect assimilation and uniformity of the coinages of British India, Australia, and the mother country, would, no doubt, be of immense advantage to all; but, like other reformations where nationalities, prejudices, and peculiarities of habit consequent upon them, have to be combated, the change will be the work, not of a day, but of a generation at least. Perhaps the Decimal System may eventually prove to be the lever by means of which the improvement is to be effected. It is exceedingly probable that the general circulation of a gold currency in India may lead to a similar result in China. There is a great interchange of bullion and specie constantly going on between the two countries, and a common and well understood coinage of gold would, undoubtedly, be found conducive to a facility of remittance and disbursement. The Chinese authorities, of course, exercise exclusive control over the currency of China, but English coins, from their known value and unvarying degree of purity, pass current, or at a very slight depreciation, at present, and it is pretty certain that Chinese merchants will accept the same coin when they know that it is already a legal tender in India, with which place they have close and facile communication.

In this way then it is, to say the least of it, not unlikely that our own gold coinage will find its way not only to Chinese seaports, but up the great Chinese rivers to the inland seats of trade of that vast, populous, and mysterious country. Thus may be foreseen the opening up of a great future for the gold coinage of England, and a gradual lapsing of the dollar, rupee, and general silver currencies of China and India into the subsidiary positions which silver coins occupy in almost all other states of the globe. Whether the relative values of the two precious metals will be affected by this social change, is a question which as yet can only be suggested. It is positive, nevertheless, that the legalization of gold, as a medium of circulation in our Indian territories, will speedily liberate enormous quantities of the inferior material, and that this latter will flow over a much wider area than it could while it remained

an exclusive standard. Without entering into a discussion of the ulterior consequences of the extensive gold discoveries of the last twelve years, and the future price of that metal—which form important and interesting subjects of debate in themselves—it may be remarked that a no less eminent authority than M. Chevalier contends that the extensive employment of a gold coinage in France has retarded a fall in the value of gold. How likely, then, that the circulation of gold coins among the millions of inhabitants of India will retard it still further?

During the reign of Napoleon III. gold coins have indeed almost displaced those of silver, except as to the smallest denominations of them, and thus the order of things, as compared with the reign of his uncle, has been reversed. An extraordinary exportation of silver to the East, where it has been hitherto in great request, has resulted from the alteration. For example, the export of silver from France in the year 1853 was valued at nine millions sterling; in 1854, it was more than ten millions and a half; in 1855, it amounted to twelve millions and three-quarters; while in 1857 it had reached eighteen millions and a-half. Since that period the exports have lessened in value, because the fountains whence they were drawn had become comparatively dry. The adoption of a gold currency in India will check this draining of silver from Europe yet more effectually, and the East will naturally absorb gold from Australia to supply the place of the subsidiary metal, for which it previously yearned. Perhaps, indeed, the masses of silver, borrowed as it were from France and, in a lesser degree, from England, may flow back again, by the action of the self-same law which drifted them away! The tendency of the new arrangement will inevitably be towards such a restitution.

One other reform it would be well for the Government to consider, in connection with the gold currency of India, and it refers to the Australian sovereign and half-sovereign. Those coins will find their way to India, as a consequence of the recent enactment, and they should be at once, therefore, imperialized. Their distinctive and comparatively inelegant impressions render them in every way a nuisance, when intermixed with our own gold money, and that inconvenience will be found intolerable among Her Majesty's lieges in India. It is not enough to make the Sydney coins simply a legal tender. They should forthwith be assimilated in appearance, as they are in weight, fineness, and intrinsic value, to those issued from the British Mint.

This is an essential addendum to the wise measure of reform to which we have adverted, and without which that

reform will be shorn of much of its usefulness. The demand for gold coins, both from England and Australia, will be for several years to come very great, and it is desirable that there should be no incongruity in the emanations from the stamping presses of the Royal establishment in London and its branch at the Antipodes.

THE LUNAR TAURUS (S.) AND ARGÆUS.—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

We recently described the northern division of the lunar range denominated *Taurus*, and have now to proceed to its southern region, which lies between the S.W. angle of the *Mare Serenitatis* (E) and the N.W. of the *M. Tranquillitatis* (D). The direction of the ridges which compose it is so exclusively S.S.W., that it even flattens two sides of the considerable craters *Littrow* (a double formation, next on the S. to *Lemonnier*, the bay described in our last paper), and *Maraldi* (a little further S.W.). S. of *Littrow* and S.E. of *Maraldi* lies a more conspicuous crater, *Vitruvius*, nineteen miles across, remarkable for its contrast of reflective power, the interior having only 2°, the ring 7° to 8° of brightness. Its E. side is 4500 feet above the bottom. Lohrmann remarks that it has a beautiful central hill. "The neighbourhood of *Vitruvius*," say B. and M., "is, in respect of colouring and luminosity, one of the most remarkable in the lunar surface, and its aspect alone quite sufficient to set aside the idea that the moon is nothing but a wide field of ice and snow, or, generally speaking, thoroughly homogeneous in its component parts. . . The sea is here considerably dark, and this dark colouring extends itself in one of the narrow bays as far as the N. edge of *Vitruvius*. Other portions, on the contrary, show a mixture of brighter and darker points, compared with which the rest possesses an almost bluish aspect." Among the many island-like hills, which reach out from *Vitruvius* into the sea, B. and M. observe that a high mountain, rising furthest to the east, "elevates itself 8384 feet above the E. surface, and 5850 feet above the bay to the W. At its broad southern foot stand two craters—one large but barely perceptible, and another small, very distinct, 6° bright in full moon." Lohrmann considers this ridge, with some curious hills and valleys on its

N.W. side, the most remarkable region in the whole of his Section III., which forms a square of about twenty-five lunar degrees. Attention had been previously drawn to it, however, by Schröter. In his first observation, 1788, November 4, he describes it as a straight chain of five summits, divided by parallel ravines, about thirty-seven miles long, and of a greyish colour. This, contrary to the usual rule, he found brighter when nearer the terminator, 1791, December 30, at which time he ascertained the heights of each of the summits: that furthest to the S.W. cast no measurable shadow; the others ascended gradually through successive heights of 1980, 3170, and 6570, to 10,190 feet at the opposite extremity of the range, where it drops at once in a vast and awful precipice to the plain beneath it, as is shown by the extraordinary straightness of the N. side of its spire of shade, and the perpendicularity of its direction towards the terminator. Hence Schröter justly remarks that the materials of the moon must be, at least in part, as coherent as those of our globe; and adds: "Cliffs, in our terrestrial mountains, of even 200 to 300 feet and upwards, from which we look down into the valleys lying beneath them, make a powerful impression upon the susceptible observer of the works of God. What a vast nature-scene now would not open itself fully to mortal eye? And how great, beyond all imagination great, would not the impression be, if it could gaze away from the steeply set-off peak upon the soft lunar plains of the *M. Serenitatis* and *M. Tranquillitatis?*" Another measure, 1796, August 9, under less favourable circumstances, gave him 11,490 feet, the shadow being then very differently shaped and directed—a variation which he was disposed to ascribe to atmospheric obscuration, but which might more naturally be referred to irregularities in the surface of the plain below. In two other observations he again saw it straight-edged, but shorter, and cut off square at the end.

On two occasions only have I any record of having observed this magnificent precipice; the former, 1855, November, 14 d. 6 h., the moon being 5 d. old, and 3 d. 14 h. past the greatest S.E. libration, when, notwithstanding a very low position and dim and agitated image, I could perceive a grand pointed mass of shadow; the latter, 1858, February, 18 d. 7 h. 45 m.—4 d. 21½ h. after new, 4 d. 4 h. after greatest N.E. libration. The distance of the terminator at this time from the N.E. end of the range was about equal to its length; and the great steepness of the enormous cliff was finely shewn by the very straight edge of its shadow, cast across the plain to the terminator, by which, though already narrowing in rapidly, it seemed to be truncated; only 1 h. 15 m. later, the spire of shade

extended not more than $\frac{4}{5}$ths of the distance to the terminator. I have entered into these minute particulars because the phenomenon seems to be of very transient character, and requires watching in order to catch its most striking aspect. In the first observation, part of the ring of the neighbouring crater, *Plinius* (No. 13), was just visible beyond the terminator in faint light; in the second, I have noted that the foot of the ring of the same cavity touched the terminator when the shadow was shortening. In either case *Theophilus* (85) was on the terminator, and the entrance of that grand crater into sunshine will serve as a convenient signal for the observer who wishes to secure a view of this remarkable shadow. I have once seen the mountain under the opposite illumination in the wane, but the effect was not at all striking; it was, however, too far in sunshine.

The representation of this chain by Lohrmann differs somewhat from the figures of Schr. and B. and M., but those best acquainted with the lunar surface and its delineation will not be the most perplexed by such deviations. It does not appear why B. and M. have not affixed to its apex one of those letters of reference which they have, in many instances, so liberally bestowed on objects of much less magnitude and interest; but as it is without any designation in their map I have begged permission to distinguish it by the name of *Mount Argæus,** from some kind of analogy which may be traced between its position as an outlier of the lunar *Taurus*, with that of the Cappadocian summit bearing that name, which is somewhat similarly related to the *Taurus* range in Asia Minor.†

On the W. side of *Vitruvius*, or S.E. of *Maraldi*, lie two smaller craters side by side, the one (*Vitruvius* A.) as remarkable for its steepness as its neighbour, which is not quite so large, is for its soft contour. B. and M. observe that one would be tempted by their aspect to consider the latter as a sketch, the former a finished production.

To complete our survey of *Mt. Taurus*, we have yet to examine the S.W. plateau, containing the two large craters, *Macrobius* (11) and *Proclus* (12). The former is 42 miles in diameter, and at least 12,800 feet deep; less, however, on the

* *Celestial Objects for Common Telescopes*, p. 72.

† This grand summit, the culminating point of the ridge of Antitaurus which divides Cappadocia into two parts, is now called *Ardjish* or *Erjish Dagh*. It is an extinct volcano of very noble form, rising about 13,000 feet above the sea, and capped with perpetual snow. The western and loftier of its two conical peaks is described as "bristling with needles and furrowed with cavities;" at its foot lies an immense crater of vast depth. Many years ago an unfortunate American traveller was said to have lost his life from attempting a short cut in its descent. The ancient geographer Strabo relates that both the Mediterranean and Euxine seas were visible from its summit, but this seems highly improbable.

E. side, where there is a small crater of 6½°. *Proclus*, more than 18 miles across, is of difficult measurement in depth from its position. Schröter, from a rough attempt, considered it about 11,000 feet; B. and M. thought it exceeded 8300 feet on the W., which is the deeper side. The ring (using that expression in its stricter sense) is, after *Aristarchus*, the most luminous in the moon, having 8° of light in its S., and 9° in its N. portion; the interior has only 4°. It is a remarkable fact that, with so much brilliancy, it is barely to be distinguished on the night-side. From its position Schröter inferred that it ought to be nearly as conspicuous after the full as *Aristarchus* before it—he found its site, however, either quite dark or very feebly illuminated; and much less conspicuous than the less brilliant and worse situated *Manilius* and *Menelaus*; in total eclipse, too, it disappeared while other spots retained their visibility. B. and M., who agree with him as to the fact, explain it from the narrowness of the ring, which renders it imperceptible with such low powers as are alone suitable for examining the details of the dark hemisphere.

The restricted breadth in this instance of the highly reflective portion is a curious and suggestive fact, though it is difficult to assign any probable explanation of it. If the uppermost ridge of the wall were of especial elevation, and exhibited a graduated brilliancy, we might be led to the idea of a subsequent "weathering" from the action of a low-lying atmospheric stratum. But such is not the case, and the inference would be totally at variance with appearances elsewhere. Nor is it easy to see, in the face of many adverse instances, how that particular part would be liable to a bleaching process from more rapid cooling, or from the escape of vapour. If, on the contrary, we should incline to the supposition of an original difference in material, it is difficult to conceive how, amid the violent disturbance of an eruption on so extended a scale, any separate layer of matter could be so regularly deposited, and on so limited a space. The last discharge, possibly of ashes, might have a very distinct character, but would hardly exhibit itself merely as the summit of a lofty ring. We may, perhaps, collect that if we see its pristine condition, it never could have been one of great fluidity. But it must be admitted that the subject of lunar eruption is at present enveloped in much obscurity.

OCCULTATIONS.

May 2nd, κ Cancri, 5 mag., 7h. 53m. to 8h. 37m.—4th, 36 Sextantis, 11h. 1m. to 11h. 52m.

STICKLEBACKS AND OTHER NEST-MAKING FISH.

BY THE REV. W. HOUGHTON, M.A., F.L.S.

So much has of late years been written on the subject of Sticklebacks' nests, that few people, who take any interest in Natural History pursuits, can be ignorant of this extremely interesting fact; but, though the *fact* itself may be well known, I will venture to say that very few naturalists, comparatively speaking, can say they have ever *found* a fish's nest, and many would experience at first some little difficulty in discovering one. With a view, therefore, of facilitating the discovery of sticklebacks' nests this season, let me ask the reader to accompany me, in thought, any day in the months of May and June, to a pond or shallow stream. We will take with us a hand-net, and a tin or zinc can, for the capture of specimens, and a separate vessel for the nests and eggs. Let us suppose that we are on the bank of a clear pond; now for a stickleback's nest. I lie flat down upon the grass, and gently move away with my hand the floating leaves of the pond-weed (*Potamogeton natans*) and the green conferva, and look about me. Ah! do you see that little fish with crimson breast, and eyes like emeralds sparkling; see how wide awake he looks; depend upon it he has a nest not far away. And here it is, very plainly to be seen, partly covered with the sand and mud at the bottom of the water. Do you notice those roundish holes in the nest? Just touch it with the end of your walking-stick. Bravo, little stickles! he is at you like a bull-dog. How angry he is; if his power were equal to his will, he would swallow us all up. Now we can easily catch him. So I put my net near his nest, and over the net he swims, and out of the water he comes, and I put him in my collecting tin. Now, let us watch the nest, and see what will happen. Here they come, a hungry group of sticklebacks of all ages, and, alas! for the depravity of piscine nature, they are attacking the nest, and devouring the precious morsels inside. Let us restore the father fish to his native element and his familiar haunts. Quick, or the work of destruction will be complete. In he goes, and for a moment seems to have lost all recollection of past events. But no! he is "coming to himself," and witnesses that marauding crowd, and now he rushes boldly to the rescue of his house and family, first tilting at one and then at another of the enemy, until, *mirabile dictu*, he has driven every vanquished foe far from the scene of carnage, a very Diomede in the fray—

> "So raged Tydides, boundless in his ire,
> Drove armies back, and made all Troy retire."

But he has other work to do, he must repair the home of his young family so ruthlessly attacked; and now he hastens hither and thither, carrying in his mouth little bits of weed and stick, and dubs them into his nest, till the work of repair is completed. But we will try to find another nest, in order to examine it somewhat minutely. Now that the eye is familiar with the appearance of a nest, there will be no difficulty in discovering many more. There, you may count no less than four within a radius of a couple of yards! Let us take this one for examination. Bah! it has collapsed and lost its form now that it is out of the water; but see, embedded in the tangled mats of grass rootlets and decayed conferva filaments, lies a cluster of eggs. Look closely at it. What are those little black specs? Why, the eyes of the young ones to be sure; and see how the embryos jerk themselves about within the egg shell. We will catch the father fish if possible, and take the nest and eggs home to watch the development in a basin of water. Poor fellow! he evidently has a father's heart, and misses his loss. He will, however, soon make himself at home in the aquarium, and you will have the opportunity of witnessing further instances of parental affection in a small fish. You will see him frequently poised over the nest and agitating the water briskly with his fins. This he does in order to bring fresh currents to the eggs. In a few days, perhaps, the young ones will begin to appear—strange looking creatures to be sure, each with an undeveloped mouth, and an attached yolk sac, the contents of which become gradually absorbed by the body of the fish, and which are its sole nutriment in the early stages of its existence. If you move away a little fellow from the nest by means of a camel's-hair pencil, you will see the father fish start off in pursuit of the wanderer, seize him in his mouth, and shoot him out into the nest. Having "no ticket of leave," he is not allowed to stir above an inch or two from the precincts of the house.* Woe betide any other fish or small animal that dares approach the home of the little family. Quick as thought Paterfamilias rushes at him with dorsal and pectoral spines bristling horribly, and pursues him "tooth and nail" with relentless fury. If you come to this same pond in about three weeks' time, you may see many little groups of small fry disporting themselves close to the nest, into which they immediately pop should an enemy make an assault at an unguarded moment.

Well, all this is extremely interesting, and you ask

* Mr. J. H. Horsfall has observed that the male fish, on some occasions, devours his own infants. See INTELLECTUAL OBSERVER, No. xxv., Feb. 1864, p. 5.

whether this nest-making peculiarity is shared by any other fish besides sticklebacks.

Yes it is, and the fact was observed by Aristotle three hundred years before the Christian era. Not that the father of natural history, it is probable, had ever seen it himself. He simply gives the story as it had been related to him. Aristotle speaks of two kinds of fish which protect their eggs, one the Glanis, of which he writes:—"Of river fish the male Glanis manifests great care for its young; but the female, after having deposited her eggs goes away, but the male continues to guard them, paying only so much of attention to them as to drive away other fish, lest they should carry the eggs away. He does this for the space of forty or fifty days, till the fry have grown strong enough to escape being devoured by other fish. The fishermen know when it is guarding its eggs, for it drives off other fish, and utters a murmur as it rushes at them. So affectionately does it watch its eggs, that when the fishermen attempt to bring them out of deep into shallow water, the fish will not leave them." Aristotle also speaks of a fish called the Phycis, as being the only marine species which manifests the same anxious care for its brood. The *glanis* of the Ancient, and *glanidi* of the Modern Greeks, is found in the Achelous in Acarnania, and is a not very distant relative of the Sheat fish, or *Silurus glanis*, of which we have recently heard so much. The Phycis is probably a species of Goby, which Cuvier thought to be identical with the *go* of the Venetians. This fish is found in the Adriatic, and the male makes a nest of the roots of the grass-wrack (*Zostera marina*), that long, ribbon-shaped weed, with its beautiful leaves of grass green, common on our own shores. I suspect that this is the fish of which Ovid has sung in his Halieuticon* as the fish "which imitates under the waves the pretty nests of the birds."

The family of *Siluridæ* are especially notable for their nest-building habits. I have already mentioned the case of the *Glanis*. Agassiz speaks of another member of this same family. "Who can see the cat-fish (*Pimelodus catus*)," he asks, "move about with its young brood, or the sun-fish (*Pomotis vulgaris*) hovering over its eggs, and protecting them for weeks, without remaining satisfied that the feeling which prompts these acts is of the same kind with that which attaches the cow to its calf." The genus *Doras*, containing two species of nest-making fish, belongs to this same family of *Siluridæ*. In these instances both the male and female fish take part in the construction of the nest, and protection of the eggs and

* "Atque avium dulces nidos imitata sub undis." (line 122.)

young fry. The negroes of Demerara, where these *Hassars,* as they are called, are found, very readily catch the fish by putting their hands into the water near the nest, when the parent fish rushes furiously at them, and is thus captured. Dr. John Hancock, who has given an interesting account of these *Hassars,* one of which he calls the Flat-headed, the other the Round-headed Hassar, thus speaks of the nests:—"The Round-head forms its nest of grass, the Flat-head of leaves. Both at certain seasons burrow in the bank. They lay their eggs only in wet weather. I have been surprised to observe the sudden appearance of numerous nests in a morning after rain occurs, the spot being indicated by a bunch of froth, which appears on the surface of the water over the nest. Below this are the eggs, placed on a bunch of fallen leaves, or grass, if it be the littoral species, which they cut and collect together. By what means this is effected seems rather mysterious, as the species are destitute of cutting teeth. It may possibly be by the use of their serrator arms, which form the first ray of the pectoral fins." The *Callichthys,* another genus of this family, manifests the same care for its young.

The stickleback, the especial subject of this paper, is the three-spined species (*Gasterosteus aculeatus,* Lin.). Yarrell enumerates several species of this fish, but Mr. Couch* regards most of these as mere varieties, and recognizes only three species, viz., the one just named, the ten-spined (*G. pungitius,* Lin.), and the fifteen-spined stickleback (*G. Spinachia,* Lin.), a species entirely marine. All these, I believe, are nest-builders. There is no doubt whatever about two of them, for the nests of both have been seen by several observers, but I cannot call to mind at present any notice of the nest of *G. pungitius.* This species is not uncommon in ditches, and I have often found specimens, but hitherto have searched in vain for their nests. The three-spined sticklebacks are inhabitants of both salt water and fresh. Mr. Couch, one of our best authorities on all that relates to the habits of fish, remarks that "they do not in preference frequent the open sea, and that a quiet union of the sea water with the fresh appears the most congenial with their nature—as we may judge by the abundance to be met with in such situations." The same author states that so numerous are they, that "in some places they are employed for the purpose of feeding ducks and pigs; and sometimes they are drawn on shore in such heaps as to serve for manure, for which purpose they are said to be of considerable value—a fact not improbable, when, according to Lacépède, they are known to afford, by pressure, a good supply

* *Fishes of the British Isles,* i. pp. 167—184. Groombridge and Sons.

of oil, which we suppose can come only [chiefly?] from the liver." I am able to mention another use to which our little stickleback friends are applied. A friend of mine, whilst partaking of a dish of whitebait, was surprised to find the presence of certain very sharp spines in that said much appreciated dainty. Lo, there they were sticking in his tongue and between his teeth! He brought a bottle of whitebait home, in which three or four sticklebacks were readily recognized.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

BY G. M. WHIPPLE.

1865.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2·30 P.M., and 5 P.M. respectively.		
			Calculated.								
Day of Month.	Barometer, corrected to Temp. 32°*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9·30 A.M.
	inches.	°	°	...	inch.	°	°	°	0—10		inches.
Jan. 1	...	...	...	...	...	36·3	31·4	4·9	...	... ...	0·000
„ 2	29·724	30·7	29·2	·95	·190	36·4	21·4	15·0	10, 10, 10	—, SSE, SE by S.	} ·091
„ 3	29·648	32·9	30·9	·93	·206	34·8	23·9	10·9	10, 8, 10	N, NW by N, NW.	
„ 4	29·907	44·3	38·9	·83	·307	49·4	28·8	20·6	8, 9, 0	WSW, W, SW.	·000
„ 5	30·011	43·4	43·1	·99	·297	49·1	36·5	12·6	7, 10, 10	W by S, S, SW.	·000
„ 6	30·034	40·1	37·8	·92	·265	42·5	38·9	13·6	0, 7, 3	W, WNW, W by S.	·223
„ 7	30·313	37·4	33·0	·85	·241	44·0	31·2	12·8	6, 0, 4	SW, WSW, SW.	·000
„ 8	...	...	...	...	...	46·1	32·5	13·6	...	... ...	·002
„ 9	29·813	42·2	36·1	·81	·285	45·7	37·7	8·0	0, 10, 10	SW, W by S, SW.	·010
„ 10	29·773	47·9	44·3	·88	·347	49·7	39·4	10·3	9, 10, 10	SW by S, SW by S, SW.	·002
„ 11	29·723	43·2	41·1	·93	·295	46·8	41·2	5·6	8, 8, 10	SW by S, SSW, S by W.	·046
„ 12	29·110	43·8	39·4	·85	·301	47·5	42·4	5·1	10, 7, 6	S by E, SW by S, SSW.	·043
„ 13	29·112	36·6	31·9	·85	·234	46·2	32·0	14·2	0, 8, 10	WSW, SW by S, S by W.	†·780
„ 14	28·697	42·9	33·9	·73	·292	46·1	34·7	11·4	10, 10, 4	SW, W by N, W by N.	·402
„ 15	...	...	...	...	...	42·0	37·9	4·1	...	... ...	·045
„ 16	28·979	37·7	33·1	·85	·244	40·6	34·0	6·6	6, 7, 4	WSW, NW, SW.	·000
„ 17	29·189	34·2	29·7	·85	·215	38·0	32·0	6·0	1, 5, 0	SW by W, NW, NW by W.	·005
„ 18	29·335	34·9	32·0	·90	·221	37·7	30·0	7·7	8, 10, 10	—, W, WSW.	·015
„ 19	29·459	34·9	33·1	·94	·221	36·4	33·0	3·4	10, 10, 10	—, N by W, NW by N.	·010
„ 20	29·591	34·0	30·0	·87	·214	37·8	31·2	6·6	7, 4, 0	WSW, S by W, W.	·000
„ 21	29·635	29·0	28·2	·97	·179	37·9	21·5	16·4	8, 7, 10	—, —, —.	·000
„ 22	...	...	...	...	...	33·6	22·2	11·4	...	... ...	·000
„ 23	29·805	32·3	28·8	·88	·201	36·2	25·4	10·8	1, 6, 8	SW by S, SE, E by S.	·000
„ 24	29·613	34·2	28·7	·83	·215	35·9	28·6	7·3	10, 10, 10	NE, NE by E, ENE.	·000
„ 25	29·661	32·8	28·1	·84	·205	34·1	32·2	1·9	10, 10, 10	NE, NE by E, E by N.	·049
„ 26	29·301	33·1	32·8	·99	·207	34·8	32·0	2·8	10, 10, 10	E by N, NE by E, ENE.	†·164
„ 27	29·158	32·3	31·0	·95	·201	33·8	32·5	1·3	10, 10, 10	NNE, N, NNW.	†·732
„ 28	29·910	30·7	21·8	·73	·190	35·4	25·8	9·6	0, 0, 0	WNW, W by S, WSW.	†·264
„ 29	...	...	...	...	...	36·1	16·7	19·4	...	... ...	·000
„ 30	29·267	36·9	35·5	·95	·237	39·8	21·6	18·2	10, 6, 10	E, SE by E, —.	†·188
„ 31	29·179	39·8	38·3	·95	·262	43·7	34·5	9·2	6, 10, 10	S by W, SSE, SSE.	·027
Daily Means.	29·536	37·0	33·5	·89	·241	...	...	9·7	...	... ...	3·098

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch. † Rain and melted snow.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—JANUARY, 1865.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
Hour. 12	8	1	9		11	24	11	8	12	20	9	17	5	19	22	10	3	6	4	7	3	2	4	17	10	13	14	18	3	12	7	10·3
A.M. 1	13	3	8		11	22	10	10	11	22	8	20	4	8	19	13	3	5	6	5	3	5	2	17	10	13	15	15	4	14	5	10·1
2	8	2	4		11	18	9	11	10	20	7	20	6	9	20	15	5	5	5	5	2	6	5	20	12	12	14	15	1	15	5	9·9
3	15	1	1		12	26		15	13	20	5	20	6	15	18	14	7	5	5	3	2	8	3	23	12	13	18	13	2	16	3	10·8
4	11	2	3	123	10	32		20	12	20	5	20	4	33	25	14	9	4	4	4	0	6	4	25	9	13	16	13	1	18	7	11·9
5	9	2	4		10	27		12	8	22	4	25	6	20	21	11	10	5	2	5	1	5	3	21	10	17	16	12	1	16	4	10·7
6	10	0	7		10	23	40	10	10	20	2	25	10	24	22	11	9	5	3	4	2	6	3	15	9	20	17	14	1	17	5	10·8
7	10	2	8		11	28		9	11	18	6	29	12	23	18	10	9	4	3	5	1	7	2	19	2	23	19	14	1	12	4	11·0
8	10	1	5		12	20		8	9	17	5	41	12	28	13	10	6	6	2	5	0	6	5	18	8	17	20	11	1	12	4	10·8
9	12	1	10		12	20		9	9	18	7	34	9	36	12	9	5	5	1	3	1	3	4	11	6	16	23	8	1	10	5	10·3
10	14	1	11	12	10	25	8	14	15	26	7	35	12	31	16	12	8	4	0	7	0	4	2	15	9	12	22	10	5	5	10	11·7
11	13	1	9	11	13	28	10	11	17	24	11	35	14	29	18	13	4	7	3	9	2	7	5	15	11	12	20	11	6	5	10	12·4
12	15	6	6	19	10	29	12	17	16	25	14	29	16	33	18	13	9	6	4	7	3	8	2	11	13	11	20	10	10	3	11	13·1
P.M. 1	16	9	5	15	7	24	14	11	17	26	10	33	15	33	19	14	6	6	3	8	3	8	2	14	10	13	18	6	11	4	10	12·6
2	17	9	4	15	5	22	13	15	17	23	12	29	14	35	17	13	6	7	4	7	1	10	2	15	12	13	18	9	11	5	14	12·7
3	12	10	5	9	6	19	11	16	16	22	8	24	16	33	13	18	8	5	3	5	2	6	5	15	13	11	21	6	12	4	14	11·9
4	11	6	5	7	19	18	9	18	16	27	6	22	19	35	11	5	3	5	7	6	5	6	5	14	15	10	21	5	10	4	15	11·7
5	10	10	4	7	18	15	10	13	16	25	4	22	20	23	11	6	4	3	7	4	2	3	6	16	15	15	19	5	12	4	14	11·1
6	12	8	5	9	16	14	10	20	18	26	9	12	31	27	17	7	4	5	7	3	2	3	7	13	15	15	19	6	16	3	17	12·1
7	12	9	6	10	17	16	10	19	20	24	11	19	34	19	15	5	4	5	5	5	4	3	8	13	12	15	21	7	19	4	16	12·5
8	7	11	8	12	19	13	12	20	22	12	11	15	24	23	11	6	5	5	7	5	2	4	8	13	8	17	21	6	19	2	10	11·5
9	6	12	5	9	20	15	9	18	24	10	15	14	20	22	10	8	4	6	4	4	4	5	9	12	9	17	20	6	17	2	7	11·1
10	4	14	7	12	23	15	9	19	22	8	19	5	20	25	11	7	4	7	5	5	4	5	11	9	9	16	16	7	21	4	12	11·4
11	2	16	5	10	20	15	9	13	22	8	16	11	19	20	13	4	3	6	2	3	4	4	13	11	13	14	15	5	16	4	11	10·5
12																																
Total Daily Movement.	257	137	144	280	313	508	216	336	363	483	212	556	348	603	390	248	138	126	96	123	53	130	120	372	252	348	443	232	201	195	220	11·3

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1865.	Reduced to mean of day.		Calculated.			Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain—read at 9.30 A.M.
	inches.	°	°		inch.	°	°	°	0—10		inches.
Feb. 1	28·861	42·5	39·3	·89	·288	48·8	34·1	14·7	10, 9, 10	—, SW by S, SW by S.	0·213
" 2	29·117	45·4	42·3	·90	·319	50·5	37·2	13·3	8, 10, 8	SW, SW, SW.	·021
" 3	29·186	41·7	39·7	·93	·280	46·2	39·3	6·9	10, 7, 10	E, SE by E, —	·075
" 4	29·558	33·7	32·3	·95	·212	36·3	35·8	0·5	10, 10, 10	ENE, E by N, ESE.	·001
" 5	...	...	...	...	...	37·6	31·9	5·7	...	... ...	·000
" 6	29·960	36·7	36·4	·99	·235	39·9	33·6	6·3	10, 10, 10	W, SSW, SSE.	·100
" 7	29·821	45·9	44·9	·96	·324	49·4	36·2	13·2	10, 10, 10	SSW, SW, SSE.	·050
" 8	29·951	35·6	29·1	·80	·226	39·7	36·9	2·8	10, 10, 10	N, NE by N, NNE.	·108
" 9	30·339	33·8	22·6	·67	·212	38.0	31·2	6·8	1, 5, 4	NNE, NE by N, NE by N.	·002
" 10	30·571	32·3	25·2	·78	·201	36·0	30·3	5·7	10, 9, 8	NE, NNE, NNW.	·000
" 11	30·553	24·5	22·7	·94	·152	29·9	25·2	4·7	10, 7	ESE, ESE.	·012†
" 12	...	...	...	...	...	33·2	24·3	8·9	...	... ...	·000
" 13	30·211	25·0	21·9	·89	·155	28·7	23·5	5·2	10, 10, 10	E, NE by E, NE.	·049†
" 14	30·205	27·3	22·9	·85	·168	30·2	23·5	6·7	10, 10, 10	NE by E, E, E.	·000
" 15	29·920	27·1	21·0	·80	·167	30·8	16·3	14·5	10, 0, 7	—, ENE, W by N.	·000
" 16	29·378	30·5	28·6	·93	·189	40·0	17·8	22·2	10, 10, 10	—, E by N, E.	·000
" 17	29·363	34·0	28·5	·82	·214	38·4	28·9	9·5	0, 10, 5	WNW, SSW, SW.	·422†
" 18	29·637	39·0	34·4	·85	·255	45·4	31·2	14·2	0, 10, 9	SW, SW by S, SW by W.	·013
" 19	...	...	...	...	...	42·3	36·5	5·8	...	... ...	·073
" 20	30·128	32·3	20·0	·64	·201	36·4	29·0	7·4	0, 0, 0	NW by W, NW by W, NW by N.	·013†
" 21	30·254	30·5	28·3	·92	·189	33·8	27·6	5·2	10, 10, 10	W, S by E, S.	·000
" 22	30·273	38·3	38·1	·99	·249	42·6	30·9	11·7	10, 10, 10	SW, SW, SSW.	·095
" 23	30·300	46·6	43·3	·89	·332	50·7	35·7	15·0	9, 10, 10	W by N, SW, SW by W.	·030
" 24	29·668	42·3	37·2	·83	·286	46·8	43·2	3·6	10, 10, 9	SW by S, N by W, NW.	·138
" 25	30·192	42·4	34·2	·75	·287	47·1	34·5	12·6	0, 9, 10	NW by W, NNW,—	·367
" 26	...	...	...	...	...	46·1	35·1	11·0	...	... ...	·030
" 27	30·122	42·6	35·7	·79	·289	47·2	38·6	8·6	8, 9, 10	—, SW by S, S.	·131
" 28	29·546	47·0	38·5	·75	·337	50·9	41·1	9·8	10, 9, 3	SW, W, W.	·002
Daily Means.	29·880	36·5	32·0	·85	·240	...	...	9·0	...	... ...	1·945

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.
† Rain and melted snow.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—FEB., 1865.

Day.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Hourly Means.
Hour.																													
12	8	16	6	3	12	6	13	6	5	20	7	6	17	14	4	5	11	16	30	27	15	1	3	22	8	5	10	13	11·0
A.M. 1	4	14	1	3	11	5	16	6	4	20	7	7	20	12	3	4	15	15	30	19	14	0	5	22	7	5	9	14	10·4
2	3	13	5	2	10	1	15	10	9	19	6	8	19	11	1	2	12	16	27	18	11	1	5	25	8	5	19	17	10·6
3	4	15	4	9	9	2	15	12	12	15	8	10	21	13	3	4	13	13	20	20	13	1	6	26	7	4	12	21	11·1
4	7	17	5	11	12	1	21	11	16	12	19	9	23	12	1	1	15	15	23	22	12	1	7	24	6	5	9	23	12·1
5	8	18	6	10	11	2	16	13	12	14	18	7	19	12	2	4	19	13	20	20	8	2	9	21	5	6	7	22	11·6
6	3	16	9	15	15	3	15	9	12	9	15	8	16	12	0	5	16	11	22	16	6	2	7	23	6	11	5	21	11·0
7	1	16	1	14	11	5	14	4	13	9	14	5	12	9	1	5	17	10	20	20	6	2	9	24	6	8	2	20	9·9
8	2	16	2	13	12	3	11	9	17	11	7	8	16	12	2	4	17	11	21	22	6	5	8	24	4	12	1	19	10·5
9	2	15	2	13	10	4	12	10	18	9	8	10	15	10	3	1	18	10	22	26	8	4	9	23	6	16	2	18	10·9
10	6	19	4	16	12	2	11	15	23	12	12	16	13	16	3	4	16	13	33	27	12	6	11	20	12	16	4	28	13·6
11	9	17	8	15	9	5	13	15	12	11	6	15	12	18	2	5	16	15	33	28	9	4	10	18	10	16	4	22	12·8
12	13	14	5	13	6	6	12	18	25	14	4	14	12	19	1	7	13	15	36	25	8	6	10	14	12	20	2	22	13·1
P.M. 1	12	13	4	13	7	8	13	22	20	15	2	16	16	21	3	11	17	14	33	28	8	6	8	18	11	21	3	21	13·7
2	13	13	1	11	8	5	11	22	23	13	2	17	18	20	5	13	15	15	38	29	7	5	7	14	6	23	10	20	13·7
3	14	14	0	17	6	6	10	18	20	8	4	19	21	18	5	15	19	18	43	23	9	5	12	11	2	24	12	19	14·0
4	12	12	0	15	9	7	8	19	19	7	4	20	15	18	3	17	23	17	39	21	7	7	9	15	5	20	9	19	13·4
5	11	11	5	20	9	7	5	18	15	5	4	18	15	14	7	11	16	20	30	17	4	4	11	13	2	18	9	16	12·0
6	12	10	4	17	10	6	6	15	13	6	4	19	15	13	4	7	15	18	27	19	2	4	12	11	2	14	11	14	11·1
7	13	9	4	16	7	8	5	17	10	4	5	19	15	9	6	7	17	26	28	17	2	5	13	8	3	13	12	15	11·2
8	13	10	4	15	9	7	7	16	9	2	6	12	13	9	5	8	15	26	26	16	0	2	11	11	4	9	15	18	10·8
9	14	7	3	14	5	10	10	15	11	5	12	19	11	9	6	10	12	28	26	16	1	3	15	9	5	7	13	18	11·2
10	16	8	2	13	5	13	9	12	12	7	11	19	12	8	3	11	13	28	26	17	1	5	16	10	5	6	16	18	11·5
11	15	5	5	12	8	12	9	5	15	6	11	22	12	8	4	9	15	27	25	14	1	5	21	5	4	5	13	17	11·1
12																													
Total Daily Movement.	215	318	90	300	223	134	277	317	345	253	196	323	378	317	77	170	375	410	678	587	170	86	234	411	146	289	209	455	11·8

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE AT THE KEW OBSERVATORY.

LATITUDE 51° 28′ 6″ N., LONGITUDE 0° 18′ 47″ W.

1865.	Reduced to mean of day.					Temperature of Air.			At 9·30 A.M., 2.30 P.M., and 5 P.M., respectively.		
			Calculated.								
Day of Month.	Barometer, corrected to Temp. 32°.*	Temperature of Air.	Dew Point.	Relative Humidity.	Tension of Vapour.	Maximum, read at 9·30 A.M. on the following day.	Minimum, read at 9·30 A.M.	Daily Range.	Proportion of Sky clouded.	Direction of Wind.	Rain read at 9·30 A.M.
	inches.	°	°		inch.	°	°	°	0—10		inches.
Mar. 1	29·650	43·6	36·7	·79	·299	48·8	41·1	7·7	8, 8, 2	WNW, W, W by N.	0·012
„ 2	29·771	42·1	34·6	·77	·284	48·3	40·8	7·5	10, 4, 3	SW by W, W by N, NWbyW	·110
„ 3	30·296	39·9	30·2	·71	·263	47·2	33·8	13·4	10, 6, 3	W by N, W by S, NW by W.	·011
„ 4	30·061	39·0	34·4	·85	·255	45·8	28·4	17·4	10, 9, 9	SW by S, SW by S, S.	·003
„ 5	...	...	...	...	...	45·2	32·2	13·0	...	... ...	·170
„ 6	29·249	35·8	33·7	·92	·228	39·5	35·0	4·5	10, 10, 10	N by E, N by E, N.	·072
„ 7	29·617	37·6	28·7	·73	·243	43·3	33·3	10·0	7, 7, 8	NWbyW,NWbyN,NWbyW	·011
„ 8	29·688	36·0	28·2	·76	·229	40·9	28·8	12·1	10, 9, 4	NW, N, N by W.	·000
„ 9	29·941	36·5	26·1	·69	·234	43·2	34·1	9·1	3, 9, 3	N, N by W, N by W.	·000
„ 10	29·797	33·9	32·4	·94	·213	39·9	30·0	9·9	10, 10, 10	SW, SW, WSW.	·000
„ 11	29·751	36·8	34·2	·91	·236	42·9	35·6	7·3	7, 10, 10	N by E, N, N.	·111
„ 12	...	...	...	...	...	40·8	33·8	7·0	...	... ...	·045
„ 13	29·844	36·9	26·9	·70	·237	42·9	33·8	9·1	6, 7, 8	NW by N, E, ESE.	·014
„ 14	29·884	34·5	29·8	·85	·218	39·4	34·4	5·0	10, 9, 10	NE, NE, NNE.	·000
„ 15	30·035	34·1	28·3	·81	·215	38·5	32·9	5·6	10, 10, 10	NE by N, NNE, N by E.	·009
„ 16	30·020	35·1	27·0	·75	·222	40·1	33·1	7·0	10, 10, 8	NE by N, N, —.	·000
„ 17	29·923	37·0	29·7	·77	·238	43·6	30·3	13·3	10, 7, 9	ENE, E by S, SE.	·000
„ 18	29·993	33·7	30·4	·89	·212	39·3	29·5	9·8	10, 10, 10	E, E, E by N.	·000
„ 19	...	...	...	...	...	38·3	34·2	4·1	...	... ...	·000
„ 20	29·921	28·6	18·1	·68	·176	34·2	26·2	8·0	0, 0, 1	ENE, ENE, ENE.	·000
„ 21	29·993	31·7	22·0	·71	·197	38·3	23·3	15·0	0, 1, 8	NE, NE, NE by E.	·000
„ 22	29·937	36·1	25·5	·69	·230	42·7	28·5	14·2	2, 4, 3	N by W, NNW, NW.	·000
„ 23	29·829	36·2	27·5	·74	·231	41·7	30·4	11·3	6, 7, 9	NW by W, N, NW.	·000
„ 24	29·810	35·6	26·6	·73	·226	41·8	28·0	13·8	0, 2, 7	N by W, NW by N, NNW.	·000
„ 25	29·675	34·9	29·9	·84	·221	42·8	26·0	16·8	2, 10, 10	SW by W, SW, SW.	·000
„ 26	...	...	...	...	...	38·9	34·0	4·9	...	... ...	†·177
„ 27	30·023	34·7	23·3	·66	·219	40·6	27·2	13·4	2, 6, 5	NNE, N by E, NW.	†·014
„ 28	30·058	35·9	29·2	·79	·229	42·5	26·0	16·5	0, 10, 10	SSE, SSW, ESE.	·000
„ 29	30·040	33·1	28·7	·86	·207	37·6	29·5	8·1	10, 10, 10	ESE, SSE, SSE.	†·049
„ 30	30·254	39·9	28·5	·67	·263	45·9	30·0	15·9	0, 5, 6	W by N, N by W, —.	·002
„ 31	30·164	45·0	39·3	·82	·314	53·3	30·0	23·3	0, 10, 10	WSW, W, WSW.	·000
Daily Means.	29·897	36·4	29·2	·78	·235	...	...	10·8	...	...	0·810

* To obtain the Barometric pressure at the sea-level these numbers must be increased by ·037 inch.

† Rain and melted snow.

HOURLY MOVEMENT OF THE WIND (IN MILES) AS RECORDED BY ROBINSON'S ANEMOMETER.—MARCH, 1865.

	Hour.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Hourly Means.
	12	21	6	14	4	20	6	10	2	18	6	17	9	2	7	17	1	3	3	27	32	28	5	8	5	6	12	15	0	4	3	1	10·1
A. M.	1	20	10	11	5	10	8	10	1	17	5	16	7	2	10	13	1	3	3	27	35	30	6	7	8	5	17	13	2	5	3	2	10·1
	2	17	9	6	4	5	9	4	1	18	7	17	9	3	12	15	2	4	1	28	33	23	6	6	3	4	14	15	3	5	2	2	9·3
	3	16	6	8	4	3	9	7	2	16	4	16	8	2	12	13	1	6	3	29	33	19	9	8	3	4	13	13	3	6	1	2	9·0
	4	16	7	7	3	6	7	9	4	19	4	19	7	5	11	17	2	12	2	33	37	20	6	6	7	3	13	11	3	5	1	1	9·8
	5	39	8	10	3	7	4	9	8	17	3	20	10	3	12	12	1	10	7	33	41	20	9	7	5	6	12	10	4	5	0	1	10·8
	6	11	7	11	1	7	3	11	7	17	5	18	9	2	13	11	1	10	10	26	38	14	10	8	4	7	15	10	3	6	2	4	9·7
	7	11	10	12	3	9	2	12	8	18	7	20	10	3	14	10	1	12	10	29	44	17	10	6	4	7	16	13	3	5	0	5	10·7
	8	18	11	10	2	10	3	16	8	19	7	20	10	2	17	10	1	10	9	25	50	22	18	8	8	8	11	15	5	5	4	6	11·9
	9	17	9	11	6	18	5	15	11	18	8	22	12	3	18	12	6	13	7	32	47	20	21	11	14	11	20	15	6	9	4	5	13·7
	10	15	15	11	15	22	10	16	14	22	12	27	14	2	20	12	6	8	16	38	37	17	24	11	17	16	23	19	8	7	8	7	15·8
	11	18	15	12	20	21	13	12	19	22	16	30	13	5	18	14	7	9	20	42	39	17	23	12	16	19	26	16	10	11	7	9	17·1
	12	19	15	15	25	19	15	15	20	23	16	30	13	6	21	10	8	11	20	47	44	16	22	14	14	20	28	17	12	11	7	14	18·3
P. M.	1	20	23	18	27	21	18	13	20	23	21	22	12	3	21	10	3	13	22	40	52	17	22	10	8	22	29	15	7	8	9	11	18·1
	2	19	27	16	27	19	16	13	19	22	19	27	11	3	17	9	4	11	25	44	46	17	22	10	17	20	27	15	11	6	7	10	17·9
	3	21	28	13	29	20	19	11	19	18	20	20	9	1	21	8	3	14	20	41	47	15	19	13	15	21	30	14	10	8	7	10	17·5
	4	23	27	8	26	16	19	9	15	17	16	22	4	3	23	8	1	9	26	44	50	18	17	10	8	22	32	12	9	5	7	6	16·5
	5	13	23	9	26	16	15	9	14	15	16	21	1	7	29	6	4	5	26	41	37	14	17	12	8	17	26	7	9	5	2	6	14·7
	6	13	23	5	26	14	16	2	8	16	15	16	3	10	20	5	3	7	27	42	35	15	9	10	5	16	26	2	7	6	1	8	13·3
	7	9	24	2	30	10	11	3	9	17	10	17	2	9	16	5	4	6	28	43	30	8	7	9	6	17	27	3	4	7	2	6	12·3
	8	13	18	3	31	10	10	2	9	13	16	16	2	9	18	1	4	2	27	35	24	8	8	9	3	17	22	2	4	8	1	7	11·4
	9	11	23	3	33	9	10	1	15	12	16	12	3	7	16	3	4	3	25	36	24	9	6	7	3	19	17	1	3	10	2	8	11·3
	10	8	20	2	30	12	5	3	19	13	16	11	4	7	16	1	3	6	24	35	20	9	6	8	5	17	18	1	3	10	3	7	11·0
	11	10	16	3	25	8	10	2	17	11	14	11	2	7	14	1	2	7	27	32	27	6	9	3	7	11	16	3	5	8	1	8	10·4
	12																																
Total Daily Movement.		398	380	220	405	312	243	214	269	421	279	467	184	106	396	223	73	194	388	849	902	399	311	213	193	315	490	257	134	165	84	146	13·0

SECCHI AND FAYE ON THE SUN.—OBSERVATIONS BY CHACORNAC.

M. Faye communicates to the French Academy* a letter received by him from Father Secchi of the Roman Observatory, on the constitution of the sun, and we proceed to extract the most important remarks in the epistle of the former, and the comments of the latter.

Father Secchi considers that Carrington's researches indicate the sun to be either altogether fluid, or, at any rate, much more so than might have been expected from the tenuity of his photosphere, or luminous envelope; and from this state of things he conceives a strong and permanent supply of heat may arise through the caloric disengaged by matter passing from the liquid to the crystalline or vesicular condition, and also from the heat disengaged in processes of dissociation, such as we have explained in former numbers detailing the experiments of St. Claire Deville. He agrees with M. Faye that the sun's layer of transparent atmosphere may be regarded as of moderate thickness, but of considerable refractive power. Such a view would coincide with the observations of Mr. Carrington, who has shown systematic deviations in spots moving towards the sun's margin which might be due to solar refraction.

Father Secchi finds the bodies known as willow leaves or rice grains all over the sun's surface, but scattered and ranged in a convergent manner towards the centre of the nuclei of spots, and also in the contour of the penumbræ and in their interior, giving rise to the well known serrated appearance.

Recently he observed a bright white line which divided a nucleus, break itself up into willow leaves on the grey bed of the penumbra. Viewed from any point in the sun the willow leaves must have enormous dimensions, far exceeding those of the cumulus clouds that float in our atmosphere. But our cumuli have rounded forms, while the objects in the sun are elongated. Can this, he asks, result from the movement of transport towards the centre of the spots and from the tendency to fill them up? He thinks that inquiry into the constitution of other bodies may elucidate the phenomena of the sun, and he confirms Mr. Huggins' discovery of the gaseous spectrum afforded by the Orion nebula.

In commenting on Father Secchi's letter, M. Faye alludes to the labours of De la Rue, Balfour Stewart, and Loewy, which taken in conjunction with those of Carrington, confirm the opinions of Wilson and Herschel and justify his (M. Faye's)

* See *Comptes Rendus*, 1865, No. 10.

objections to the theory of the solar photosphere and spots put forth by Kirchhoff.

He cites an opinion of Secchi, that as in our atmosphere we have a substance—water—capable of transforming itself into a fine dust* and into a vesicular state, capable of suspension in clouds, so there may be in the solar atmosphere a quantity of material capable of assuming similar conditions at an elevated temperature.

These corpuscles would act like solid particles suspended in gases, and would exert, as Magnus has shown, a greater radiating power, both calorific and luminous, than the vapour in which they floated. This would explain why the spots, or places in which the clouds were torn and interrupted, radiated less light and heat, although their temperature might be the same.

If Kirchhoff was right in assuming that invisible layers of an immense atmosphere external to the photosphere absorbed certain solar rays, and thus produced the dark lines of the spectrum, we ought to obtain from that outer atmosphere, when its action could be isolated, a spectrum the exact converse of that afforded by the photosphere. In 1842, M. Fasinieri took advantage of a total eclipse to obtain this spectrum, and found it completely dark in the space usually occupied by the green. It was a discontinuous gaseous spectrum, and by no means the converse of a solar spectrum. Bearing in mind these facts, M. Faye thinks the absorption of certain rays may take place in the photosphere itself, a supposition which would require us to regard solar light as emanating not only from the surface of the photosphere, but as also coming from various depths. If the existence of a photosphere was preceded by a gaseous condition in which no solid matter existed, researches, like those of Mr. Huggins, may trace in other bodies the history of changes which the sun has undergone.

M. Faye observes that if the rice grains or willow leaves owe their elongated form to currents in the sun's atmosphere careful photographs made in the approaching period of the minimum spots and least disturbance may show a noticeable regularity in their direction. The disappearance of the rice grains from, and the appearance of willow leaves and straws in spots may, he thinks, be explained by supposing that in such places there are strong descending currents, which carry the bodies downwards and cause us to see them in elongated perspective.

He thinks the best photo-heliographs would be taken by presenting the glass to the sun with the collodion surface behind

* It is not correct to regard steam as water *dust* or fine spray.

and not in front. He likewise recommends a blackened paper to be placed behind the collodion film to absorb the light and prevent reflection.

OBSERVATIONS BY M. CHACORNAC.

We are indebted to M. Chacornac for a copy of *Bulletin des Observations faites à Ville-Urbanne,* on some groups of sun spots seen on the 6th March, 1865, at 9h. 0m. On this occasion the regions of the penumbræ exhibited a series of layers superposed in *echelon.* This appearance, M. Chacornac remarks, is not rare, but in this case it coincided with an analogous disposition of the interior strata, plunging down into the dark regions of the central body.

M. Chacornac observes that when spots close up it is nearly always possible to perceive in their depths *bridges,* which take the form of meshes of a net-work formed of a glutinous matter (*matière glutineuse*), the superficial layers corresponding with others at greater depths. In the spots seen at the above date "the meshes of the pasty matter (*corps pâteux*) lying beneath the photosphere had a stretched-out appearance, evidently arising from traction movements operating in different directions, either by the expansive force of the gas visibly escaping from the orifices, or by the fall of strata, which seemed to plunge towards the centre through the weakening of the strata that supported them; or perhaps by reason of movements of translation occurring in deep strata, and due to currents in a direction opposite to those of the upper layers. These phenomena show an evident relation between the pasty shell (*écorce*) and the liquid medium of the centre."

M. Chacornac refers the formation of spots to two sorts of actions. In the one he says it is like the enlargement of an originally-formed aperture by the escape of vapours from a pasty mass in fermentation. In the other it is as if the surface was engulphed at certain points in such a manner as to form an elevated margin, with a slope or *talus* more or less inclined to the solar surface. This configuration has the aspect of vent holes (*soupiraux*), having their axes inclined to a normal to the sun's surface.

When a large spot suddenly appears, the engulphing action takes place at all points of the circumference, and almost simultaneously. "The changes effected by the concurrence of the two kinds of action cause a dispersion of incandescence chiefly in a vertical direction, and the spot no longer exhibits a penumbra." When the engulphing action is rapid, it swallows up small adjacent spots, and the size of the chief one becomes enlarged. From the vicinity of several centres of activity,

lateral tractions and currents in opposite directions arise. "When we examine the structure of the body below the photosphere, we find that its appearance of being pierced with orifices, through which vapours are discharged, will account for the shapes usually taken by spots and by simple pores. If we follow the changes of the photospheric crystals deposited or situated on the sloping branches of bridges, like those of the 6th March spot, which plunge down into the dark cavity, we observe the following facts. When, by reason of the movements which transport large bodies into the depths of the crater, they (the photospheric crystals) are carried into the dark cavity—into the region of dissociation, if we may employ the term—they seem to evaporate and dissipate, after they have passed a certain limit, just as dappled atmospheric clouds behave under the influence of a warm current."

From the preceding passages, which we have given as literally as possible from M. Chacornac's paper, the reader will be prepared to learn that he regards the stratum below the photosphere as pierced with innumerable little craters, or vent-holes, through which vapours escape, and tear the luminous envelope to a greater or less extent. He considers that the region of most intense light does not extend beyond the faculæ; that below them is a less luminous region—that of the penumbræ—in which the same actions take place, but with less intensity.

Speaking of the appearance of "lines of dislocation," M. Chacornac observes, that at the beginning of the spots which form the chief subject of his remarks, "all the vent-holes (*soupiraux*) of the margin opened simultaneously, and arranged themselves in an arc of a great circle. Some hours later, some of these orifices were almost shut, and others considerably enlarged; but all were displaced so that the chain of them presented a sinuous line, as if the entire mass supporting the pasty outer layer (*écorce pâteux*) was influenced by currents varying in velocity according to their heliocentric latitude. Thus, in spite of relative displacement, the eruptive centres sensibly preserved their forms. Is not this a proof that the orifice of the crater is pierced through a medium of a certain consistence, and that the entire mass is displaced?"

In another passage, M. Chacornac speaks of having continuously watched spots which joined to others of larger dimensions by traversing a space of 17″ in three hours, while for three consecutive days he has seen a small spot remain without change of form on the margin of a large opening. There are thus periods during which the sun's outer layer (*écorce*) seems to be fused with a rapidity that manifests the

activity of a solar volcano, while at other times a volcano of large opening is comparatively quiescent.

During the last two months (preceding 6th March), M. Chacornac has remarked that spots entering the visible hemisphere remained quiet while in the margin of the disc, became active as they progressed from the margin, and gradually closed after passing a particular central region. This action is, he observes, in conformity with the remarks of the President of our Astronomical Society concerning the action of the planet Venus.*

With regard to faculæ, M. Chacornac observes, that notwithstanding what he has recently written, "it is certain that they arrange themselves in long trains converging towards an active centre of eruption, like immense rivers suddenly formed and proceeding directly or by branches from all directions. It is no longer doubtful, from the nature of their configuration, considered with reference to the solar volcanoes, that they are currents of photospheric matter pouring themselves continually into the cavity of a spot, whose intermittent eruptions continually disperse them." He adds, that they have a tendency to form in the direction of meridians rather than of latitude parallels.

STAR COLOURS.

Few objects in the whole round of nature exercise a deeper fascination on the mind than coloured stars. Analogy leads us to regard each star as the centre of a system more or less resembling that aggregation of planets around a central sun, to which we belong. A single star of conspicuous colour invites us to speculate upon the effects its richly-tinted beams may have upon the animal and vegetable life that we conjecture lives and thrives upon the worlds revolving around it; and though astronomy, calling to her aid the kindred sciences of chemistry, botany, and biology, can afford but slender hints concerning the probable nature of the herbs that may cover the surface of distant globes, of the form and hue of the flowers that may adorn their changing seasons, of the trees that may compose their forests, or of the creatures that may luxuriate in their sunshine or their shade, still our fancy loves to picture the unknown scenes, and to cherish the hope that our spirits may one day be able to traverse the

* The President of the Society was speaking of the evidence on this subject obtained by the researches of Mr. Balfour Stewart.

fields of space, collecting knowledge as we wander from orb to orb.

If single stars of bright colour so strongly appeal to the imagination, binary, or more complex systems, in which the colours are contrasted, suggest more beautiful pictures, and prompt to more elaborate speculations. What, for example, must be the aspect of the skies of planets that may cluster round Albireo (β Cygni) and rejoice in the commingling or alternation of the sapphire and topaz beams. Somewhat similar inquiries are suggested by stars remarkable for rapid changes of hue; such, for example, as Capella, whose vivid chromatic flashings attract the most careless eye; or the strange portentous combinations and alternations of red and green that gleam from Antares, in Scorpio, when that extraordinary star is viewed through a telescope of moderate size. The first question that arises is, are the colours real attributes of the bodies that seem to emit them, or results of our terrestrial atmosphere, or of the tendency of the eye to be affected by accidental tints? The influence of our atmosphere, though in one sense a shifting quantity, is yet constant in another; and as the same star is seen at different seasons, and at different hours in different parts of the heavens, and at different elevations above the horizon, we can, by collating a number of observations, arrive at tolerably precise results; and we find that if we eliminate changes obviously belonging to the stars themselves, that the star colours retain a considerable amount of fixity, whether seen near the zenith, or at moderate heights above the horizon, and that weather changes of greater or less transparency only cause their appearances to differ, as might be expected from the optical effects of air in different states of dryness, moisture, motion, and homogeneity, or the reverse. Thus, whether Sirius was red or not to the ancients, it is a white star to us, though somewhat blueish, as M. Babinet* states, in towns, through the impurities of their air. Arcturus in like manner belongs to the yellow series, and Vega to those of pale sapphire tint. Star colours, then, are not made by our atmosphere, but only modified more or less, according to its condition at the time. Some portion of their colour is the result of the law of simultaneous contrast, which M. Chevreul has treated in his well-known work. Thus M. Babinet states that a deep blue sky has been observed to make Venus look of an orange complexion. Two stars of contrasted colours seen in the same telescopic field, and near each other, will heighten or modify each other's tints according to their relative intensities of the complimentary colours which

* See an interesting letter of M. Babinet to Admiral Smyth, in *Astronomical Register*, for April.

they induce our eyes to see. Thus, red and green will each look brighter and more decided when in simultaneous view. This source of colour would be sufficient to account for some stars appearing different from their real hues; but it may be eliminated by a bar or wire that keeps one star out of view while the other is seen. By such means the position and real character of star colours is assured, and we ask what do they proceed from?

This question will be better answered when we have made out a little more concerning our own sun. At present it seems as if the light of the sun and stars emanated from intensely heated vapours holding solid particles, hot enough to be luminous, in suspension. The carbon particles in common gas, as in the gaseous products of a oil lamp, have a yellowish tinge; molten silver is greenish, and the lime light tinged with blue. The atmosphere which probably surrounds the luminous matter of our sun, or of other suns, obstruct certain rays, as the dark lines of the spectrum show; but with this exception we probably see sunlight and starlight pretty much as it is emitted by the luminous matter, that is, within the limits of our sight, for we cannot perceive rays that exceed or fall short of a certain velocity in their vibration, or of a certain refrangibility.

An accumulation of facts, some of which have been recorded in the papers of Mr. Webb, and others of the same kind, which we leave for his abler pen to describe, have given a new interest to coloured stars, by showing that they are liable to alterations and changes, some of which appear periodical. The observation and due registration of these changes will afford a useful and delightful occupation for amateurs, and with a view to give precision to this class of inquirers, Admiral Smyth has proposed, in a privately issued work, called *Sidereal Chromatics*, a certain scale for comparison. He gives four tints, each diminishing in intensity, of red, orange, yellow, green, blue, and purple, leaving whites to be described, in the order of their purity and brightness, by the terms—1, creamy white; 2, silvery white; 3, pearl white; 4, pale white. A suggestion from Admiral Smyth is sure to be of value in itself, and to be well received by all astronomical observers, and we apprehend the only doubt that will arise will concern the method of employing his chromatic scale, and in this matter, with great deference for his opinion, we must profess a little disagreement, as we think it will be necessary to employ qualifying adjectives to a greater extent than he suggests. The more most coloured stars are looked at, the more will most observers be convinced that they are neither a simple tint of a primary or of a secondary colour, and in many cases the hue is of so much complexity as to render it difficult to say what it is.

Now in such cases a simple reference to tints, such as "red 3, blue 4," would, we think, be insufficient. If, for example, a number of observers, with different telescopes, assign a certain greenishness to the blue companion of Albireo, the fact should be recorded, and "blue 2" would require to be supplemented by an appropriate adjective. Admiral Smyth's tints appear to us admirably chosen for the purpose he has in view, and we should like to see them imitated in coloured solutions, or in coloured glass, which we think would be more convenient that flat tints on paper, as the light seen through transparent bodies affords a nearer approach to the luminous effect of stars.

We are glad to see by citations, which Admiral Smyth makes from Dawes, and other eminent authorities, that Horne and Thornthwaite's "aplanatic eye-pieces" are appreciated for these inquiries. We spoke highly of them on their first appearance, and prolonged trials have confirmed our good opinion.

There are many topics of importance in Admiral Smyth's work—which is a reprint, with additions, from his former publications—on which we abstain from commenting now, because we know they are engaging the attention of Mr. Webb, who will bring them forward in due time. We shall now only record our thanks to the Admiral for his new and important aid to the study of double stars, and conclude by wishing our telescopic subscribers to examine *Cor. Caroli*, and send us an account of the colours of the component stars, stating the size of the object-glass, sort of eye-piece, and power employed. Admiral Smyth gives a number of estimates of these colours, as they seemed to different eyes, and finally describes them himself as, A, pale reddish white; D, lilac: or in his scale, A, red 4, purple 3. We confess we should not have called it red, and shall be much interested in knowing and publishing what other observers see.

ON THE STRUCTURE, AFFINITIES, AND GEOLOGICAL POSITION OF EOZOON CANADENSE.

BY WILLIAM B. CARPENTER, M.D., F.R.S., F.L.S., F.G.S.

(*With Two Illustrations.*)

Among the communications made to the British Association at its recent meeting at Bath, there was certainly none of higher scientific interest than the announcement by Sir William Logan, the director of the Canadian Geological Survey, of the discovery of large masses of a fossil organism referable to the Foraminiferal type, near the base of the Laurentian series of rocks in North America. The geological position of this fossil, indicating the vast remoteness in time of its existence as a living organism, is scarcely more remarkable than its zoological relations; for, at what (so far as we at present know) was the dawn of animal life upon our globe, it affords evidence of a most extraordinary development of that Rhizopod type of animal life which now presents itself only in forms of comparative insignificance,—a development which enabled it to separate carbonate of lime from the ocean-waters, in quantity sufficient to produce masses rivalling in bulk and solidity those of the Stony Corals of later epochs, and thus to furnish (as there seems good reason to believe) the materials of those calcareous strata, of whose occurrence in the Laurentian series it had previously been impossible to give a satisfactory account.

Having been requested by Sir William Logan to verify the conclusions regarding the nature of this fossil which had been arrived at by Dr. Dawson of Montreal, and having been kindly supplied by him with ample materials for the further elucidation of its structure, I propose in the present paper to direct attention to the points of most striking interest, Geological as well as Zoological, which this discovery brings into view. And since the bare statement that the *Eozoon* occurs near the base of the Laurentian series of rocks, will not convey, save to such as have followed the most recent progress of geological research, any definite idea of the extraordinary interest that attaches to the marvellous glimpse which its presence there affords into the ancient life of our globe, I shall in the first instance take back my readers to that stage in the history of the science, which preceded the establishment of the "Silurian system" by Sir Roderick Murchison.

Geological Position of Eozoon.—Under the general designation "Primary Rocks" was formerly ranked an immense series of formations, some evidently stratified, others presumed to be non-stratified, chiefly originating in the disintegration of the

granite on which they rested, and consisting of gneiss, mica-schist, clay-slate, quartz, alum-shale, grauwacke, with occasional limestone beds. The older of these rocks were not supposed to contain any fossil remains; and from the indications they presented of changes in their condition subsequent to their original deposition, they were distinguished as *metamorphic.* In the newer strata, on the other hand, the presence of fossils had been recognized; but no such comparison had been made between these and the fossils of the Old Red Sandstone and Carboniferous Limestone (which were the oldest strata that had then been systematically studied), as threw any light on their mutual relations.

It was a little more than thirty years ago that Sir Roderick (then Mr.) Murchison was enabled, by the careful study of the order of superposition of the newer of these rocks in South Wales and along the Welsh border, to establish the existence of a regular series of strata, graduating downwards continuously from the lower beds of the Old Red Sandstone, and characterized by a distinct and peculiar assemblage of organic remains; and this series he designated the *Silurian system,* the region which had first revealed its existence being that once inhabited by the ancient Silures. The base of this series (which was marked out into Upper and Lower Silurian, both by a want of geological conformity and by differences in the fauna of the two divisions) was supposed to be formed by the hard beds of fissile sandstone largely developed near the town of Llandeilo in Carmarthenshire, and known as the "Llandeilo flags." These rest unconformably upon what was then designated the "Clay-slate" system; and it seems to have been at first assumed by the investigator of the Silurian system, that organic life had no existence on the globe previously to the epoch thus marked out.

But whilst Sir Roderick Murchison was thus working out in South Wales the later portion of the series of "primary rocks," Professor Sedgwick was applying himself with equal zeal and energy to the study of the older, as displayed in Cumberland and North Wales; and he succeeded in proving that whilst a regular order of superposition, broken however by many disturbances, may be traced through that massive series of slaty rocks of which a large proportion of the mountain ranges of Cumberland and North Wales are composed, the newer of these rocks present fossil remains in sufficient numbers to show that it was incorrect to assume the absence of life in those ancient seas. Thus a thick stratum of fissile sandstone underlying the "Tremadoc slates," which, again, lie beneath the Llandeilo flags, contains such a vast abundance of shells of the still existing genus *Lingula,* that this stratum

is known by the designation "Lingula-flags." For the whole series of stratified rocks underlying the original Silurian system of Sir R. Murchison, the names of *Cambrian* or *Cumbrian,* indicative of its special development in North Wales and Cumberland, were proposed by Professor Sedgwick; but geologists for some time hesitated in admitting it as a distinctly characterized group. The fossil types which it contained did not seem to differ so much from those of the Lower Silurian strata, as to justify the separation of the Cambrian from the Silurian fauna; and it was argued by Sir Roderick Murchison that there was more reason for carrying downwards the base of his Silurian system, so as to make it include the Lingula flags and the slates which intervene between it and the Llandeilo flags, than for admitting the existence of any pre-Silurian life. Even as late as 1851 we find so impartial and highly-qualified a judge as Sir Charles Lyell thus expressing himself on this point (*Manual of Elementary Geology,* 3rd ed., p. 361):—"Below the Silurian strata in North Wales, and in the region of the Cumberland Lakes, there are some slaty rocks devoid of organic remains, or in which a few obscure traces only of fossils have been detected, for which the names of Cambrian and Cumbrian have been proposed. Whether these will ever be entitled, by the specific distinctness of their fossils, to rank as independent groups, we have not yet sufficient data to determine."

The required data had been already furnished, however, by the labours of M. Barrande in Bohemia; in which country the older stratified rocks are developed even more remarkably than in Britain. Although scarcely more than twenty species of fossils had been previously obtained from this locality, M. Barrande had already acquired in 1850 no fewer than 1100 species; namely, 250 crustaceans (chiefly trilobites), 250 cephalopods, 160 gasteropods and pteropods, 130 acephalous mollusks, 210 brachiopods, and 110 corals and other fossils. This vast assemblage he found to comprise not merely the equivalents of the Upper and Lower Silurian fauna, but also a fauna clearly distinguishable from the latter, and designated by him "primordial," under the belief that it afforded evidence of the first appearance of life on this planet, and that consequently no fossiliferous strata of older date would or could ever be discovered;—an anticipation as vain as that which the founder of the Silurian system had entertained respecting the strata which he originally adopted as its base.

The peculiarity of the so-called "primordial fauna" specially consisted in the distinctness of its Trilobites from those of the Lower Silurian strata; not only the species, but even many of the genera, discovered by M. Barrande having been previously

unknown. And the occurrence of these generic types in strata very remote geographically, has served to identify them geologically; so that no doubt any longer remains that the Upper Cambrian rocks of North Wales, the alum-schists of Sweden, and the Potsdam sandstone of the United States (formerly ranking as the lowest member of the North American Silurians) with an underlying series of slaty rocks extending from New York to Newfoundland, belong to the same epoch as the Bohemian strata supposed by M. Barrande to present the earliest forms of organic life.

But below the Tremadoc slates and Lingula flags which constitute the *Upper* Cambrian, there is a vast series of sandstones and slates, known as "Harlech grits" and "Llanberis slates" (sometimes designated the "Longmynd" group, from being the components of the hills of that name in Shropshire), which constitute the *Lower* Cambrian series. The organic remains hitherto discovered in these are extremely scanty as regards number of *types;* consisting only of five species of Annelids and one obscure Crustacean form in the Harlech grits, and two species of the Zoophyte *Oldhamia* in the Irish equivalent of the Llanberis slates. But the number of *individual* Annelids whose remains are preserved is enormous; they are stated to occur in countless myriads through a mile in thickness in the Longmynd.

Of the immense lapse of time that must have been occupied in the deposit of the Cambrian strata, both the nature of their materials, which must have been derived from the disintegration of rocks of exceeding hardness, and their vast thickness afford ample evidence. The Tremadoc slates are estimated at 2000 feet, and the Lingula flags at 6000, making 8000 feet for the *Upper Cambrian.* Again, the Harlech grits present a thickness of from 6000 to 7000 feet, and the Llanberis slates about 3000, thus giving 10,000 feet as the thickness of the *Lower Cambrian.** The labours of our Canadian geologists have brought to light a series of strata in the neighbourhood of Lake Huron, and thence designated *Huronian,* which are believed to be the equivalents of our Lower Cambrian, and which attain a thickness of not less than 18,000 feet. These consist chiefly of quartz-rock, with great masses of greenish chloritic slate, which sometimes include pebbles of crystalline rocks belonging to the still older Laurentian formation to be presently described. No organic remains have yet been discovered in this series, but beds of Limestone occur in it, one of them 300 feet in thickness; and as the

* The above figures are those given by Sir C. Lyell. By Professor Phillips the Longmynd strata are spoken of as "supposed to be 20,000 feet thick or more."

belief has been gradually gaining ground among geologists, that all limestones have been originally formed by the agency of Coral-polypes, Echinoderms, Mollusks, etc., which fix carbonate of lime from sea-water, just as plants fix carbon from the atmosphere, the mere fact of the occurrence of a limestone bed in strata otherwise non-fossiliferous, raises a presumption that organic life had not been wanting, even at that very early period. And it is to this epoch, represented in our own country by the Lower Cambrian strata, that one of our ablest and most experienced geologists, Professor Phillips, has recently assigned the origin of life on the earth.* He points out that in passing downwards through the Lower Palæozoic strata, the forms of life grow fewer and fewer, until in the lowest Cambrian rocks they vanish entirely, though these strata are of a kind such as might be expected to yield them. And the deficiency is not confined to the British types of the series; it is equally noticeable in their equivalents in North America, in Norway, and in Bohemia—countries well searched for this very purpose. "The absence is general; it seems due to a general cause. Is it not probable that during these very early periods the ocean and its sediments were nearly devoid of plants and animals, and in the earliest time of all, which is represented by sediments, quite deprived of such?" The following table is given by him as showing the marked reduction in number of types as we descend to the lowest beds of the Lower Silurian, and thence to the Upper Cambrian; this last reduction involving the entire loss of the representatives of a large proportion of the higher groups of mollusca. To complete the table we add a line, in which are noted all the types yet discovered in the Lower Cambrian.

		Amorphozoa	Foraminifera	Zoophyta	Echinodermata	Annelida	Crustacea	Polyzoa	Brachiopoda	Monomyaria	Dimyaria	Gasteropoda	Heteropoda	Pteropoda	Cephalopoda
Upper Silurian	Ludlow	...	1	10	17	18	39	1	30	17	41	27	4	4	30
	Wenlock	3	...	66	34	6	36	25	79	12	15	18	3	3	22
Middle Silurian	Llandovery	2	...	26	6	3	16	5	69	5	13	26	6	3	13
Lower Silurian	Caradoc	3	...	23	20	8	82	27	67	7	31	25	7	7	26
	Llandeilo	...	...	4	...	7	34	22	18	1	2	3	2	6	4
Upper Cambrian	Lingula	...	...	2?	...	2	11	1	3	...	...	...	...	...	...
Lower Cambrian	Longmynd	...	...	2	...	5	1	...	...	...	...	...	...	...	...

* *Life on the Earth; its Origin and Succession.* Cambridge, 1860.

Structure of Eozoön.

If Professor Phillips had introduced into this table the far richer fauna of the Upper Cambrian strata in Bohemia, the comparative poverty of organic life in that epoch would have seemed less striking; but, on the other hand, the diminution in the number of types as we pass from the Upper to the Lower Cambrian, would have been still more obvious. "No doubt," he remarks, "it is open to any one to compare this approach to a Hypozoic zero with the reductions of life to a minimum above the Palæozoic, and above the Mesozoic deposits; and to *suppose* that below the Palæozoics *were* other earlier strata, and earlier systems of life, though they are now all lost in the general metamorphism which has produced the gneiss and mica schist. No one is likely to believe this, however, who attends seriously to the facts regarding the successive appearance of the classes, orders, families, genera, and species, as we search the records of geological time." More philosophical in its appreciation of what Mr. Darwin calls "the imperfection of the geological record," and more true as the event has proved, was the remark of Sir C. Lyell upon the "primordial" assumption of M. Barrande—"I have been opposed from the first to a nomenclature the adoption of which would seem to imply the acceptance of such a theory; for I always felt sure, on contemplating the past history of geology, that we had not yet pushed our inquiries into the past so far as to lead us to despair of extending our discoveries at some future day, when vast portions of the globe hitherto unexplored should have been thoroughly surveyed."

This sagacious anticipation has been marvellously verified by the discoveries which the excellent geologists of our Canadian survey, under the able direction of Sir William Logan, have recently made in the region of which the exploration was committed to them: for they have shown that the rocks which compose the Laurentian mountains in Canada, and the Adirondacks in New York, spreading over an area of about 200,000 square miles, belong to a system distinct from and antecedent to the Cambrian, just as the Cambrian form a system distinct from and antecedent to the Silurian.* These *Laurentian* strata consist chiefly of quartzose, aluminous, and argillaceous rocks, like the sedimentary deposits of less ancient times; but for the most part in a condition of *metamorphism* which has given them a crystalline character. By a break in the continuity of the strata they are marked out into two distinct groups, the Upper or Labrador series resting unconformably on the Lower; and the united thickness of these groups in Canada is certainly not less than 30,000 feet, and probably

* See the *Quarterly Journal of the Geological Society*, February, 1865, pp. 45—50.

much exceeds that vast amount.—The Lower part of the Laurentian series is represented in Scotland by the "fundamental gneiss" of Sir Roderick Murchison, which forms the whole of the island of Lewis, and on which, in various parts of the western highlands, the Lower Cambrian and various metamorphic rocks rest unconformably. The Upper, or Labrador group, seems to be represented by the Labradorite and Hypersthene rocks of Skye; which, though formerly supposed to be unstratified, correspond so closely with those of the Labrador series in Canada and New York as to leave no doubt that they belong, like the latter, to a regularly stratified system.—The "primitive gneiss" formation, again, which attains at least an equal thickness in Norway, has been shown to correspond with the Laurentian series of Canada; and the "primitive slate" formation which rests upon it is no less remarkably similar at once to the Huronian of Canada and to the Lower Cambrian of our own island.—The labours of Sir Roderick Murchison in Central Europe have shown that the ancient gneissic series of Bavaria and Bohemia, which underlies the "primordial zone" of Barrande, with a vast thickness of intervening clay-slate, corresponding to the Lower Cambrian, is the equivalent in position of the Laurentians of Canada and Scotland; and that, like them, it is divisible into an older and a newer series, the two together attaining the colossal thickness of 90,000 feet.

The following Table represents the general results of the inquiries whose history has been thus briefly sketched; showing the present state of our probable knowledge of the two vast series of stratified rocks, the Cambrian and the Laurentian, which underlie the Lower Silurian:—

GREAT BRITAIN.	NORTH AMERICA.	SCANDINAVIA.	CENTRAL EUROPE.
Upper Cambrian.	Potsdam Sandstone.	Alum-schists.	Primordial zone.
Lower Cambrian.	Huronian.	Primitive Slates.	Primitive Slates.
Hypersthene rock of Skye.	Upper Laurentian	Primitive Gneiss.	Primitive Gneiss.
Fundamental Gneiss.	Lower Laurentian		

"The united thickness of these three great series" (the Huronian and the Upper and Lower Laurentian), says Sir William Logan, "may possibly far surpass that of all the succeeding rocks, from the base of the Palæozoic series to the

present time. *We are thus carried back to a period so far remote, that the appearance of the so-called Primordial Fauna may be considered a comparatively modern event.*"

Clear evidence had been found in the constitution of the Laurentian and Huronian rocks, that the same chemical and mechanical processes which have ever since been at work in disintegrating and reconstructing the earth's crust, were then in operation; the great question remaining for determination was, whether *vital* activity had any place in those ancient seas, or whether they were altogether untenanted by living beings.

This question might be presumptively answered in the affirmative by two important sets of facts. In both the Upper and the Lower Laurentian series there are several zones of Limestone, each of sufficient volume to constitute an independent formation. The aggregate thickness of these is said by Dr. Bigsby to be not less than 5000 feet thick. Similar limestones occur in Scotland, and also in Norway and Finland, where they form beds of 1000 feet or more in thickness. Since these limestones are in a highly crystalline condition, the apparent absence of fossils in them could not be considered as in any way negativing the probability that they had been originally formed by the agency of animal life, and subsequently altered by metamorphic action—such being now universally admitted to have been the history of many newer limestones in which there is a like absence of any distinguishable organic remains. So, again, the occurrence of carbon—which, in the form of graphite, both constitutes distinct beds, and is disseminated through the calcareous or siliceous strata of the Laurentian series, as well in Norway as in Canada—might be taken as an evidence of the existence of vegetation during that epoch, since no one disputes the organic origin of this mineral in more recent rocks. Further, Sir William Logan had observed that certain of the Laurentian marbles, on being struck, gave forth the same overpowering smell of carburetted hydrogen, as is well known to be given off from many beds of carboniferous limestone, whose organic origin is most distinct. And Mr. Sterry Hunt, the accomplished mineralogist of the Canadian survey, had argued for the existence of organic matters on the earth's surface during the Laurentian period, from the presence of great beds of iron-ore, and from the occurrence of metallic sulphurets.

But however strong might be these presumptions, considered either separately or collectively, they could not be regarded as in themselves by any means sufficient to establish so important a conclusion, as the dating-back the commencement of organic life from the Lower Cambrian epoch, to the immeasurably more remote period during which

the Lower Laurentian strata were in process of formation. The needed proof has been supplied, however, by the discovery of the very remarkable fossil which it is my special object to describe; the *Eozoon Canadense* thus taking rank as by far the earliest form of animal life yet known, its development having been antecedent to the deposition of the greater part of the Laurentian series, nearly the whole thickness of which, with the Huronian in addition—amounting, as we have seen, in Canada to nearly 50,000 feet, and in Central Europe to 90,000—had been superimposed upon the lowest beds in which it occurs, before the epoch of the Lingula flags, which once, in the opinion of many geological authorities, marked the first appearance of life on our planet.

The history of this discovery is in itself not a little curious. Certain bodies presenting forms apparently organic were brought by Mr. J. McCulloch to Sir Wm. Logan, in 1858, from the Grand Calumet limestone on the river Ottawa; and these were found to be composed of alternating parallel or somewhat concentric layers of crystallized pyroxene and carbonate of lime. This alternation called to mind other specimens exhibiting a similar structure, which had some years previously been obtained, by Dr. Wilson, of Perth, from the Burgess limestone, but which had been regarded merely as minerals; their forms were the same as those of the Grand Calumet specimens, but their composition was different, the alternating layers being formed of Loganite (dark green silicate of magnesia) and Dolomite (magnesian limestone). Thus in both cases the alternation, though formed by different minerals, always consisted of *siliceous* and *calcareous* layers; and hence Sir William Logan, thinking it strange that identical forms should be derived from minerals of such different composition, was led to look upon them as fossils. As such they were exhibited by him at the meeting of the American Association for the Advancement of Science in 1859; and they were shown to some of his geological friends on this side of the Atlantic in 1862. One of the specimens had been sliced and submitted to microscopic examination; but unfortunately it was one of those composed of Loganite and Dolomite, in which minute structure rarely occurs; and in the absence of any evidence from this source, few except Professor Ramsay seemed disposed to believe in their organic nature.

The true character of these bodies thus remained in suspense until a little more than twelve months ago, when Sir Wm. Logan observed indications of similar forms in blocks of the Laurentian limestone from the Grenville bed, which is the highest of the three zones of limestone occurring in the Lower Laurentian series, and which attains, in some places, a

thickness of 1500 feet. These blocks had been brought to the Museum to be sawn into marble; and on being cut through, they were found to be composed of serpentine alternating with calc-spar. Thin slices of them having been prepared, distinct evidence of organic structure was observed in the very first specimen submitted to microscopic examination. The prosecution of the inquiry was confided to that experienced observer, Dr. Dawson, the accomplished Principal of M'Gill College, Montreal; and under the guidance of the figures and descriptions which I had given of the minute structure of various types of Foraminifera, in the series of Memoirs which had found a place in the *Philosophical Transactions*, and in my general *Introduction to the Study of the Foraminifera*, published by the Ray Society, he was led to the conclusion that this organism, notwithstanding its comparatively gigantic dimensions, belongs to the group of Foraminifera; being especially related to *Polytrema* in its zoophytic mode of growth, to *Carpenteria* in the imperfect separation of the cavity of its shell into distinct chambers, and to *Calcarina* in its canal-system. By Dr. Dawson and by Dr. Sterry Hunt it was further shown that the *calcareous* layers represent the original *shell*, which in the best preserved Grenville specimens has undergone very little change, but which in the Grand Calumet specimens has become crystalline, whilst in the Burgess specimens it has been completely metamorphosed by magnesian infiltration. On the other hand, they showed that the *siliceous* layers represent the original *sarcode-body* of the animal, which has been replaced by the infiltration of various silicates, as serpentine, pyroxene, and loganite—just as the sarcode-bodies of Foraminifera of various subsequent deposits, from the Silurian to the present time, have been replaced by the infiltration of glauconite and other siliceous minerals; enabling us to obtain, by the dissolution of their calcareous shells in dilute acids, most perfect *models* of the soft parts, exhibiting the forms and connections which they possessed in life, with far more truth and completeness than they could be determined by any other method of study.*

* The existence of such "internal casts" of the shells of *Foraminifera*—the models of the bodies which occupied them during life—in the Greensands of various Geological epochs, was first made known by Prof. Ehrenberg. Not long afterwards it was shown by Prof. Bailey, that the Foraminiferal shells of our existing seas are sometimes infiltrated in like manner; and many beautiful examples of this modelling process have been obtained by Messrs. Parker and Rupert Jones, to whose kindness I owe the "internal cast" of a recent *Polystomella*, of which I have given a figure in my description of that genus (*op. cit.*), and which was well designated by my friend Prof. Blanchard as a *bijou zoologique*. I certainly would not exchange it for a diamond of the same size, since it demonstrated the correctness of my account of the very complex arrangement which I had worked-out, before obtaining it, in the canal-system of the shell of that remarkable genus.

Such models were shown by the specimens recently brought over by Sir William Logan to be obtainable by submitting portions of *Eozoon* to the action of acid, so as to remove the calcareous shell; the siliceous infiltration having not merely filled the chambers, so as to give us the precise forms of the sarcodic segments which occupied them, but having also penetrated into the "canal system," which extends itself from these into the most solid and massive portions of the shell; and, as I shall presently show in addition, having actually taken the place of those wonderfully minute threads of sarcode which traversed the porous walls of the chambers, so as to stereotype (so to speak) their exquisitely beautiful brush-like arrangement, which is thus exhibited, in by far the oldest known fossil, with a perfection that could not be imitated by any means we possess of preparing and displaying the existing animals of the same type.

External Configuration and Internal Structure of Eozoon.—Owing to the indefinite mode of growth of this gigantic Foraminifer, and the manner in which its fossilized masses are connected with the matrix in which they are imbedded, it is impossible to say with certainty either what was its characteristic *shape*, or what were the limits to the *size* of its individual growths. There is no doubt, however, that these often spread over the area of a square foot, or even more, and attained a thickness of several inches; thus forming blocks which bear a general resemblance to those of the massive Stony Corals, such as *Meandrina*. The aggregation of such blocks, whose continuous extension at their margins would bring them into contact, so that those which originally began from distinct centres would become grafted, as it were, together, seems to have formed Foraminiferal reefs, similar in their general characters to coral reefs; save that while the coral reefs of subsequent epochs, like those of the present time, usually had shells, echinoderms, etc., associated with them (as we know from their remains), in these most ancient reefs the only organic remains yet found are those of the animals which built them. In some of these reefs, from the description given by Sir William Logan, the older portions appear to have undergone fossilization before the newer were built-up on the base which they furnished. Thus, in the Grenville limestone, the lower stratum is composed of large and small masses of white crystalline Pyroxene, some of them twenty yards in length by four or five wide; these appear to be confusedly placed one above another, with many ragged interstices, and many smooth-worn, rounded, large and small pits. In these masses of pyroxene, compact as they appear, are a multitude of

small spaces filled with carbonate of lime; and these show the characteristic structure of the fossil. The spaces between them, moreover, are filled with a mixture of serpentine and carbonate of lime. The whole thickness formed by the aggregation of these masses is not less than two hundred feet; and over their surface is spread a sheet of dark-green serpentine, varying from one-sixteenth of an inch to six inches in thickness. This forms the base of a set of newer growths, composed of alternating plates of carbonate of lime and serpentine; the upper surface of which, again, appears to have been worn and broken up by currents and eddies, so as to modify whatever may have been the original surface given by the natural growth of the animal. The difference that presents itself between the deeper and the more superficial parts of the reef, in the fossilizing mineral which has filled up the cavities in the shell that were occupied during life by the sarcodic body of the animal, seems to mark a considerable difference in the conditions under which this substitution took place; while the fragmentary character of the older pyroxenic portion, and the wear of its surface into cavities and deep recesses, indicate a long period of suspension, during which disintegrating changes were going on, before that renewed growth took place which is represented by the superposed masses wherein the pyroxene is replaced by serpentine.

A vertical section of a well-preserved mass of *Eozoon* exhibits in its basal portion a more or less regular alternation of calcareous and siliceous lamellæ; the former being distinguished by their whiteness, the latter by their light-green hue. This alternation, however, frequently gives place in the more superficial parts to a mutual interpenetration of these minerals; the green spots of the serpentine being scattered over the surface of the section, instead of being collected in continuous bands, so as to give it a granular instead of a striated aspect. This difference depends on a departure from what may be considered the typical plan of growth, which often occurs (as in other Foraminifera) in the later stages; the minute chambers being no longer arranged in continuous tiers, but being piled together irregularly, or in an *acervuline* manner. The contrast between the two modes of growth is well shown by the siliceous model of the animal body which occupied the chambers, represented in the Coloured Plate; the lower portion being that which shows in vertical section a regular series of lamellæ of serpentine, the spaces between which were occupied by lamellæ of calcareous shell; while in the upper is seen the acervuline arrangement of the segments which gives rise to the scattered disposition of the serpentine granules, the calcareous shell having occupied the irregular spaces between these.

The minute structure of *Eozoon* may be determined by the microscopic examination either of thin transparent sections, or of portions which have been subjected to the action of dilute acid, so as to remove the calcareous shell, leaving only the *internal casts,* or *models,* in silex, of the chambers and other cavities originally occupied by the substance of the animal. Each of these modes of examination, as I have elsewhere shown,* has its peculiar advantages; and the combination of both, here permitted by the peculiar manner in which the *Eozoon* has been fossilized, enables us to attain a completeness of knowledge of its structure, such as is afforded by no other fossil with which I am acquainted. For in well-preserved specimens, the shelly substance often retains its characters so distinctly, that the details of its structure can be even more satisfactorily made out, than can those of most of the comparatively modern *Nummulites.* This arises from the fact, that whilst the latter, when imbedded (as they usually are) in a matrix of the same material, have been subjected to *calcareous* infiltration, which has filled-up alike their minute tubules and their larger canals, and has thus rendered the shell-substance nearly homogeneous, these tubules and canals have been filled up in *Eozoon* by a *siliceous* infiltration, which does not coalesce with the substance of the shell, so that the boundaries of the tubules and canals can be distinctly defined. But what renders the condition of *Eozoon* so peculiarly favourable for the investigation of its organic structure, is the marvellous completeness with which the minutest extensions of the sarcode-body of the animal are represented in decalcified specimens by their siliceous models; even the most delicate pseudopodial threads, consisting of the softest and most transitory form of living substance, which were put forth through pores in the shell-wall of less than $\frac{1}{10,000}$th of an inch in diameter, being thus, as it were, perpetuated to all time; and the varieties of their course being exhibited, by what appear under the microscope as most perfect models, in asbestiform fibre, having this advantage over the most skilfully executed works of human hands, that they are not *imitations,* but *the very threads themselves* turned into stone by Nature's cunning. For there can, I think, be no doubt that the siliceous mineral found its way into the cavities of the shell, not by mere *mechanical infiltration* occasioned by pressure from without, but by a process of *chemical substitution* which took place, particle by particle, between the sarcode-body of the animal and certain constituents of the ocean-waters, *before* the destruction of the former by ordinary decomposition.

* Memoir on *Polystomella,* in the *Philosophical Transactions* for 1860, pp. 538, 540; and *Introduction to the Study of the Foraminifera,* pp. 9, 10.

Interpreting the copious information which we derive from these two sources, by the knowledge we already possess of the life-history of existing Foraminifera, we find ourselves able to *reconstruct* our *Eozoon* with at least as much certainty as the comparative anatomist can restore an Iguanodon or a Plesiosaurus. And as the greater part of the details on which this reconstruction rests have been already recorded in the form and order in which they have actually presented themselves to Dr. Dawson and myself,* I prefer that the present description, and its accompanying figures, should place the creature before my readers as it existed in life, whilst building up in the ancient sea-beds those massive reefs which formed the materials of the Laurentian limestones.

The calcareous skeleton or shell of *Eozoon* might be likened to a building made up of successive tiers of chambers (Uncoloured Plate, Fig. 1); the chambers A^1, A^1, A^1, and A^2, A^2, of each tier, however, communicating very freely with each other, so that the segments of the sarcodic layer which occupied them were intimately connected, as is shown by the continuity of their siliceous models (Coloured Plate). In most existing Foraminifera, the successive chambers communicate only by narrow orifices, so that the segments of the body which occupies them are mutually connected by slender bands or *stolons*: but in *Carpenteria* we have an example of a communication nearly as free as that which exists between the chambers of the same tier in *Eozoon;* and I have occasionally met with chambers as completely isolated from the rest as are those of Foraminifera generally, the communication being established by several narrow passages (Uncoloured Plate, Fig. 1, *b, b*), exactly corresponding to those which I have described in *Cycloclypeus.* Moreover, I not unfrequently find, projecting from the surfaces of the principal layers, little groups of comparatively small segments, which have budded-forth from the larger ones, and which might almost be taken for internal casts of *Globigerinæ* or other small separate Foraminifera.

The proper walls of the chambers are everywhere formed of a pellucid, vitreous shell-substance, minutely perforated with tubuli, so as exactly to correspond with those of *Nummulites, Operculinæ,* etc. These tubuli, as in the existing representatives of the Nummuline series, usually run parallel to each other, passing directly from the inner to the outer surface of the chamber-wall (Uncoloured Plate, Fig. 1, B, B), without coalescence or ramification; and the siliceous casts of the cavities of these tubules often remain *in situ* after the removal

* See the *Quarterly Journal of the Geological Society,* February, 1865, pp. 51—66.

of the calcareous shell, standing side by side, like the filaments that form the "pile" of velvet, their lower ends resting on the subjacent segment, whilst their upper form a uniform surface so close in texture as to be with difficulty resolvable into the points of its constituent aciculi (Uncoloured Plate, Fig. 2, *a*). This residuary layer (when not thrown off, as it often is, by the disengagement of gas in the process of decalcification) is at once distinguished by its whiteness; as is shown at the upper part of the Coloured Plate on the *surface* of the segments, and at the lower in the *section* of the lamellæ. If a small portion of it be detached with the point of a needle, it is easily shown to be composed of the most delicate asbestiform fibres, each of them representing the original pseudopodium of sarcode which passed through the tubule. But, as I have shown to be often the case in *Operculina*,* the tubuli may depart from their normal parallelism, separating from each other in some parts, and becoming more closely crowded in others; so that instead of the uniform punctation which the *internal* surface of the chamber-wall exhibits, we may find great diversities in the disposition of their *external* orifices, these being often congregated in bands and clusters, with intervals of non-tubular shell-substance between them. A yet greater variety in their course presents itself in *Eozoon*. For the intervals of non-tubular shell-substance left in some parts of the chamber-wall by the crowding together of the tubules in others, are marked in the decalcified layer of asbestiform fibres by fissures in the "pile" (Fig. 2, *b*), such as would be made in the surface of a piece of velvet by doubling it back so as to separate the free ends of the filaments; whilst the convergence of the intervening fibres often unites them into minute flattened leaf-like tufts. A more marked degree of the same convergence, bringing the greater number of the pseudopodia proceeding from each segment into one bundle (Fig. 2, *c*), is not unfrequently seen in parts in which there has been a great development of the "intermediate skeleton" presently to be described; and a portion of the asbestiform layer in which this arrangement is well exhibited, constitutes, under the Binocular Microscope, one of the most beautiful objects with which I am acquainted, every individual thread glistening brightly under appropriate illumination, and holding its own proper place, while an infinite variety of detail is shown in the arrangement of the brush-like bundles, of which no two are precisely similar. Another variety in the disposition of the tubuli is one to which I have seen no parallel in other Foraminifera. Retaining their separate parallelism, they some-

* Memoir on *Operculina* in the *Philosophical Transactions* for 1859, p. 24, and Plate IV., figs. 2, 4; also, *Introduction to the Study of the Foraminifera*, p. 256.

times pass off very obliquely, or even tangentially, so as to run for considerable distances in the chamber-walls; and their asbestiform casts thus form elongated bundles lying on the surfaces of the segmented layers of serpentine.

Between the proper walls of the successive tiers of chambers, there usually intervene layers of very variable thickness (Uncoloured Plate, Fig. 1, C, C), composed of homogeneous shell-substance; these represent the "intermediate" or "supplemental" skeleton, which I have described in several of the larger Foraminifera, and which attains a peculiar development in *Calcarina*.* This is an exogenous deposit on the surface of the proper wall of the chamber, which seems to be formed by the sarcodic layer that originates in the coalescence of the pseudopodia after they have issued from its tubuli, and which is traversed by a more or less minutely distributed "canal-system," occupied during life by prolongations of that sarcodic layer. This canal-system is often brought into view in thin transparent sections of the shell (Uncoloured Plate, Fig. 1, E, E); but as the plane of section will seldom coincide with any considerable part of the course of the passages, a much better idea of their distribution is gained from the study of decalcified specimens, which present us with siliceous models of the sarcodic extensions that occupied those passages in the living animal. These extensions certainly originate in some cases in the sarcodic segments occupying the cavities of the chambers; in other instances I find them to proceed from the stems formed by the convergence of the brush-like tufts of pseudopodia; but more commonly they seem to have sprung (as I have shown to be probably the case in the recent *Calcarina*) from the sarcodic layer, which is formed by the coalescence of the pseudopodia on the outer surface of the proper wall of the chamber, this layer being represented in the decalcified specimens by a thin plate of serpentine that is often found resting on the extremities of the asbestiform bundles. They differ very remarkably in size and form: being sometimes slender cylindrical rods, which come off from the subjacent layer at regular intervals, and pass straight onwards into the shell-substance without either sub-division or junction; sometimes presenting themselves as broad flattened plates, which gradually thin out to a sharp edge; but being commonly more or less arborescent, and often presenting either beautiful denditric ramifications (lower part of Coloured Plate, andUncoloured Plate, Fig. 3) or a sheaf-like divergence of their component filaments. All these representatives of the sarcodic prolongations that occupied the canal-system are distinguished

* Memoir on *Calcarina*, in the *Philosophical Transactions*, 1860, p. 553; and *Introduction to the Study of the Foraminifera*, p. 220.

in decalcified specimens—like the acicular layers occupying the place of the proper walls of the chambers,—by their pure whiteness, which contrasts strongly with the green of the serpentine that has filled the cavities of the chambers; and though this might seem to indicate a difference in the infiltrating material, no such difference really exists. I am informed by Sir William Logan that Mr. Sterry Hunt has determined the chemical identity of the two substances; and hence it is obvious that the whiteness of the internal casts of the tubes and canals is due (like that of pounded glass) to the reflection of light occasioned by the fine division of their component particles; each rod, plate, stem, or branch, being composed of minute asbestiform filaments, which represent, it would seem, so many original threads of sarcode that partially coalesced to form a bundle. Besides these definite shapes, however, we meet in many decalcified specimens with large white amorphous masses of like composition, occupying spaces which must have been originally surrounded by the shell-substance of the intermediate skeleton. The nature of these was for some time a puzzle to me; but I fortunately succeeded in gaining a clue to their character by the decalcification of very thin sections which had traversed them; and I find that they consist in some instances of parallel lamellæ disposed like the leaves of a book, and in others of solid bunches of rounded filaments reminding one of a sailor's "swab;" thus being in each case but a mere aggregation of the elementary forms of sarcodic prolongation already described.

In those portions of the organism in which the chambers, instead of being regularly arranged in floors, are piled together in an "acervuline" manner, there is little trace either of "intermediate skeleton," or of "canal-system"; but the characteristic structure of their proper walls is still unmistakably exhibited, not only in transparent sections, but also in decalcified specimens, wherever the asbestiform layer has not been detached by the disengagement of gas from the surface of the segment on which it should rest.

The mode in which, in the regularly stratified portions of the organism, each successive layer originated from the one that preceded it, does not seem to have been always the same. There is certainly no regular system of apertures for the passage of *stolons*, giving origin to new segments, such as are found in all ordinary many-chambered Foraminifera, whether their type of growth be rectilineal, spiral, or cyclical; and although, when one layer is separated from another by nothing else than the proper walls of the chambers, the coalescence of the pseudopodia emerging from the upper surface of the last formed layer would suffice to lay the foundation of a new layer

of sarcodic segments, it is obvious that where this surface has been overgrown by a thick exogenous deposit of non-tubular shell-substance, some more special provision must exist for the origination of a new tier of chambers above this. Such a provision seems to have been occasionally made by the extension of riband-like prolongations of sarcode, through large passages left in the intermediate skeleton, proceeding from the chambers beneath, and opening on its upper surface; for I have not only occasionally met with such flattened passages in transparent sections of the shell (Uncoloured Plate, Fig. 1, D), but have still more frequently found the void spaces in decalcified specimens, left by the removal of the thickest layers of the intermediate skeleton, to be traversed by the internal casts of such passages, which seem to represent the sarcodic stolons of the living animal body.*

The origination of new layers, however, seems more frequently to have taken place in a much larger extension of the sarcode-body of the pre-formed layer; which either folded back its margin over the surface already consolidated (in a manner somewhat like that in which the mantle of a *Cypræa* doubles back to deposit the final surface-layer of its shell), or sent upwards wall-like plates, sometimes of very limited extent, but not unfrequently of considerable horizontal length, which, after traversing the substance of the shell, spread themselves out over its free surface. For it is frequently to be observed in decalcified specimens, that two bands of serpentine (or other infiltrating mineral), which represent two layers of the original sarcode-body of the animal, approximate each other in some part of their course, and come into complete continuity (as on the left-hand side of the Coloured Plate), so that the upper layer would here seem to have originated in a folding-over of the lower. And even where these bands are most widely separated, we find that they are commonly held together by vertical dykes of the same material, which traverse the intervening calcareous layers like trap-dykes passing through a bed of sandstone. That such have not been formed by mineral infiltration into accidental fissures in the shell, but represent extensions of the sarcode-body of the living animal, is indicated not merely by their distinct continuity with the horizontal layers, but also by the fact that portions of the canal-system may frequently be traced into connexion with them.

The only information which seems to me yet wanting to bring up our knowledge of the life-history of this organism to the highest level of that (still far from complete, especially as

* See the white bands passing from the middle of the lowest layer in the Coloured Plate to the layer next above it.

regards the generative process,) which we possess in respect to the best-known existing representatives of the Foraminiferal group, is that which concerns the early stage of its development. At present we know *Eozoon* only in its massive forms; and we have no clue, save that furnished by analogy, to the mode in which these are built up. In the *Rotaline* series, which is characterized by the *coarse* perforation of the shell, we find the original spire of *Planorbulina* overgrown by chambers piled upon it in an irregular acervuline manner; in *Tinoporus*, whose young state closely resembles the early form of Planorbulina, the chambers, successively superposed on the original spire and its marginal extension, are piled in layers of greater regularity; while in *Polytrema* similar rotaline chambers bud forth one from another, in such a manner as to give to the organism the aspect of a minute branching Coral, for which it was long mistaken. Now, in virtue of the *fine* tubulation of the proper walls of its chambers, *Eozoon* belongs to the *Nummuline* series, of which I have shown this structure to be the special characteristic; and this series presents a remarkable parallelism, as regards variations in mode of growth, to the Rotaline. For we may pass from the typical *Operculina* or *Nummulina*, through *Heterostegina* and *Cycloclypeus*, to *Orbitoides*, in which, as in *Tinoporus*, the chambers multiply both by horizontal and by vertical gemmation; and between this and *Eozoon* the difference is not greater as regards plan of growth than between *Tinoporus* and *Polytrema*.*

Notwithstanding the striking contrast which is presented between the massive growths of *Eozoon* and those microscopic *Rotaliæ*, *Miliolæ*, etc., which are the examples of the Foraminiferal type most familiar to collectors on our own shores, there is no more essential difference in plan of structure, than that which exists between the most insignificant flowering plant and the gigantic Wellingtonia or the wide-spreading Banyan. In the one case, as in the other, the difference consists, not so much in the size of the individual parts, as in the extent to which these parts are multiplied by the production of new buds in continuity with the pre-existing fabric. A contrast scarcely less remarkable exists among the Foraminifera of the existing epoch. Thus the shells of the minute *Globigerinæ*, which cover to an unknown thickness the sea-bottom of all that portion of the Atlantic Ocean which is traversed by the Gulf stream (the "ooze," of which specimens are brought up by the sounding apparatus, containing not less than 95 per cent. of them), consist of not more than eight or ten chambers, showing that the *continuous* increase of the individual body by

* See the descriptions of the Structure of these Generic types in my *Introduction to the Study of the Foraminifera.*

the gemmation of new segments ceased at that point; and that if new segments be still budded-off, they detach themselves, so as to lay the foundation of new *Globigerinæ*. On the other hand, in the large discoidal *Cycloclypeus* of the coast of Borneo, which attains a diameter of $2\frac{1}{4}$ inches, the number of segments formed by continuous gemmation must be many thousand.

It is a fact of no little interest, that we have another example of the comparatively gigantic development of the Foraminiferal type in what would have been formerly accounted the earliest fossiliferous rocks. Some years since, Mr. Salter, then the Palæontologist to the Geological Survey of Great Britain, showed me some fossil remains which he had received from the Silurians of Canada, and asked my opinion respecting them. My reply, after a not very detailed examination of them, was to this effect :—"If it were not for their gigantic size, I should say that they were internal casts of an Orbitolite." Having subsequently received additional specimens of these fossils, and having carefully compared them with my description of the genus *Orbitolites* in the *Philosophical Transactions* for 1855, Mr. Salter felt himself justified in identifying them with that type; and published an account of them (under the designation *Receptaculites*) with excellent illustrative figures, in the *First Decade of Canadian Organic Remains*. Now the largest recent *Orbitolite* I have seen is about the size and thickness of a shilling; whilst the Canadian *Receptaculites* attains a diameter of twelve inches and a thickness of a third of an inch; and if this had increased by vertical as well as by horizontal gemmation, piling up its chambers in successive tiers like the recent *Tinoporus* or the fossil *Orbitoides*, it would have formed a mass equalling *Eozoon* in its ordinary dimensions.

Remains of *Eozoon* are not by any means confined to Canada. The serpentine marble of Tyree, which forms part of the Laurentian system on the West of Scotland, and a similar rock in Skye, when subjected to minute examination, are found to present a structure clearly identical with that of the Canadian *Eozoon*. And the like structure has been discovered by Mr. Sanford in the serpentine marble of Connemara, well known to ornamental builders under the name of "Irish green." I have examined several pieces of this rock by placing them in dilute acid, and have not the smallest hesitation in identifying the residuum with the *acervuline* portion of the corresponding residuum of the Canadian *Eozoon*, shown in the upper part of the Uncoloured Plate: I have not, however, met with anything corresponding to the lamellated structure shown in the lower part of that plate. Moreover, I find, in place of a

continuous asbestiform layer covering the segments, long straight bundles of asbestiform filaments radiating from them. What is the import of these—whether they represent a part of the original structure of the animal, or are (as I am disposed to suspect) a product of subsequent metamorphism—is a point which must be reserved for further investigation. The age of the Connemara rock, too, can scarcely be regarded as conclusively settled. Sir Roderick Murchison, by whom its relations were carefully studied some years ago, seemed not indisposed, when it was first found to contain *Eozoon*, to believe that it might belong to the Laurentian series; but he has since withdrawn that admission, and has expressed the opinion that the Connemara marble is of Silurian age.* If this be the case, it proves that *Eozoon* was not confined to the Laurentian period, but that it had a vast range in time, as well as in geographical distribution; in this respect corresponding to many later forms of Foraminifera, which have been shown by Messrs. Parker and Rupert Jones to range from the Triassic to the present epoch.

It is much to be desired that a careful examination should be made of all Serpentine marbles that contain a Calcareous admixture. Such admixture may be at once detected by their effervescence when touched with dilute acid; and if, on the removal of the lime by continuous maceration in acid, the siliceous residuum should exhibit forms bearing any decided resemblance to either portion of the Uncoloured Plate, the participation of *Eozoon* in their original production may be confidently inferred. It is specially to be desired that search should be made for it in any limestone beds occurring in the Laurentian rocks of Scandinavia, and in those of Bohemia and Bavaria.

It is not only, however, in those rocks which exhibit well-preserved representations of the original animal, that we may trace the agency of *Eozoon* in extracting from the ocean-waters the materials now forming the solid crust of the globe. There can be no reasonable doubt that—as has occurred in many subsequent epochs, and may be shown to be in progress at the present time—there was a continual disintegration, by the mechanical force of the ocean-waters, of those structures which had been built-up by living agency; and that the particles resulting from the progressive wearing-down of the Foraminiferal reefs would be deposited as sediments elsewhere, and, when subjected to subsequent metamorphic action (as by the infiltration of heated water) would be converted into highly crystalline limestones. Sir William Logan has shown me thin sections of solid masses, which presented unmistakable

* See the *Geological Magazine* for April, 1865.

evidence, when microscopically examined, of having been made up of an aggregation of fragments of the proper walls of the chambers of *Eozoon;* these fragments presenting the most beautifully preserved examples I have yet seen in transparent section, of the characteristic Nummuline tubulation. And as these sections presented no indication of such remains of a canal-system as would have marked the presence of fragments of the intermediate skeleton, I am disposed to think that the breaking-up of the surface of the original *Eozoon* must have taken place before the proper walls of its highest tiers of chambers had been strengthened by exogenous deposit. Further, in sections of Laurentian limestones, which did not exhibit to the naked eye any evidence of organic structure, Dr. Dawson was able, by microscopic examination, to recognize minute fragments, of whose derivation from *Eozoon* there could be no reasonable doubt.

Hence, it would appear that these gigantic Rhizopods performed, in the seas of the Laurentian epoch, the same part in the production of limestone rocks which was subsequently taken by Coral polypes, Echinoderms, and Mollusks, as well as by minuter forms of Foraminifera. And it is a fact not without an important significance, that this, the lowest type of animal life known to the Physiologist, should have thus culminated in the very earliest period in the history of the life of our globe with which the Palæontologist is at present acquainted. If, as I consider, that we are quite justified in doing, we refer the animal of *Eozoon* to the type whose characteristic features we are able to study in our existing *Rotaliæ* and *Miliolæ,* we may say of it, as I have elsewhere stated of the Foraminifera generally,* that its substance "does not present any such differentiation as is necessary to constitute what is commonly understood as 'organization,' even of the lowest degree and simplest kind; so that the physiologist has here a case in which those vital operations which he is accustomed to see carried on by an elaborate apparatus, are performed without any special instruments whatever—a little particle of apparently homogeneous jelly changing itself into a greater variety of forms than the fabled Proteus, laying hold of its food without members, swallowing it without a mouth, digesting it without a stomach, appropriating its nutritious material without absorbent vessels or a circulating system, moving its parts without muscles, feeling (if it has any power to do so) without nerves, propagating itself without a genital apparatus, and forming a shelly covering that possesses a symmetry and complexity not surpassed by those of any testaceous animals." It is not possible to conceive any living being of greater simplicity

* *Introduction to the Study of the Foraminifera,* Preface, p. vii.

than a Rhizopod of the Foraminiferal type; its homogeneous jelly-like substance not being even invested by the semblance of a membrane, so that its pseudopodial extensions, when they meet each other, coalesce like the glutinous threads separately proceeding from the spinnerets of a Spider. But it *is* possible to conceive of a system of rocks preceding the Laurentian, as the Laurentian preceded the Cambrian, and the Cambrian preceded the Silurian; and it would be a most rash assumption to maintain that the first appearance of *Eozoon* above the Laurentian horizon really marked the dawn of animal life on our planet. As Dr. Dawson has justly remarked, "though the abundance and wide distribution of *Eozoon*, and the important part it seems to have acted in the accumulation of limestone, indicate that it was one of the most prevalent forms of animal existence in the seas of the Laurentian period, they do not imply the non-existence of other beings. On the contrary, independently of the indications afforded by the limestones themselves, it is evident that in order to the existence and growth of these large rhizopods, the water must have swarmed with more minute animal and vegetable organisms on which they could subsist."

It would be difficult, I think, to find a more "pregnant instance" of the value of Microscopical investigation than that which is afforded by the discovery of which I have now given an account; a discovery which I am strongly disposed to regard as only the first of many similar results, which will follow its intelligent application to the study of the internal structure of other fossils, hitherto known only by their external forms. The organic structure and precise zoological affinities of a body which was at first supposed to be a product of purely physical operations, have been shown to be determinable with certainty from the examination of a particle which a pin's head would cover; and we are thus enabled to predicate the nature of the living action by which it was produced, at a Geological epoch whose remoteness in *time* carries us even beyond the range of the imagination, with no less certainty than the Astronomer can now, by the aid of spectrum-analysis, determine the chemical and physical constitution of bodies whose remoteness in *space* alike transcends our power to conceive.

EXPLANATION OF PLATES.

The *Coloured Plate* represents the various appearances exhibited by a specimen of *Eozoon Canadense,* which has been macerated in dilute acid, so as to dissolve away the calcareous shell which originally contained the body of the animal, now replaced by its model in green serpentine. In the lower part of the plate the segments are seen to be united into continuous

horizontal lamellæ, which are connected with each other at intervals by vertical bands; in the upper part, the segments preserve their distinctness to a much greater degree, and are piled one upon another without any regular plan. The exposed surface of the segments, both in the lamellated and in the acervuline portions, is seen to be whitened by the asbestiform layer, also shown as a narrow edging in the sectional view of the lamellated portion. This layer consists of the needle-like siliceous filaments which take the place of the pseudopodia originally, occupying the minute parallel tubuli of the proper walls of the chambers, and which remain *in situ* after the removal of the calcareous shell that was traversed by them. Between the two lower lamellæ of serpentine, in the broad space originally occupied by a thick layer of the "intermediate skeleton," is seen on the right the siliceous model of a small group of stolon-processes, which passed directly from the sarcode body occupying the chambers of the lower tier to that of the tier next above, whilst on the left is shown the internal cast of a part of the canal system, forming a model in serpentine of the arborescent clusters of sarcodic prolongations which occupied it.

Tinted Plate.—Structure of Eozoon.—Fig. 1. Portion of the calcareous shell (restored), the contents of the chambers having been removed. A^1, A^1, A^1, chambers of a lower tier, communicating with each other freely at *a*, *a*, and separated from an adjacent chamber at *b*, *b*, by an intervening septum traversed by passages. A^2, A^2, chambers of an upper tier. B, B, B, B, proper walls of the chambers, traversed, as in the *nummuline* type, by fine tubules. These tubules are seen, in the upper wall of the chambers, A^2, A^2, to pass with uniform parallelism, from the inner to the outer surface, where they open at regular distances from each other; but in the upper wall of the chambers, A^1, A^1, A^1, the tubules are seen to converge in their passage outward, so as to open on the surface in irregular bands and clusters. C, C, C, intermediate skeleton, composed of homogenous shell substance, traversed at D by a stoloniferous passage connecting the chambers of two tiers, and at E, E, E by the canal system.

Fig. 2. Highly magnified portion of the asbestiform layer, left after the decalcification of the shell-wall, showing varieties in the arrangement of the siliceous internal casts of the tubules, which represent the pseudopodia that occupied them in life. At *a* is shown the uniform surface given by the ends of the closely-packed parallel *aciculi*, which are seen standing side by side in the sectional view beneath. At *b*, the uniformity of surface is interrupted by the partial convergence of the aciculi, leaving vacant spaces between. And at *c* is shown the more

complete convergence of the siliceous threads into brush-like bundles.

Fig. 3. Internal cast of a portion of the canal system, in a decalcified specimen, showing the arborescent distribution of the sarcodic prolongations which occupied it during life.

TEN YEARS IN SWEDEN.*

There is a manifest tendency towards an increase of communication and connection between England and Sweden. Its vast stores of the richest and purest varieties of iron ore, and the ample supplies of serviceable timber abounding in its extensive forests, attract the notice of the speculative capitalist, who sees in them important sources of wealth hitherto imperfectly developed, and offering splendid prospects of profit to enterprises carried out on a sufficient scale, and with adequate skill. The naturalist and the sportsman find their attention turned to Sweden from the interesting character and variety of its wild animals; while the manners of the people, their Protestant faith, and free political system, tend to render their country an agreeable residence for English families during the milder portions of the year.

It is easy to understand why, notwithstanding the merits of the people, Sweden has been somewhat slow in making the most of her resources. Though a large country—nearly three times the size of England and Wales—only a small part is fairly adapted to agriculture, and much of the wealth in minerals and timber can only become accessible through the construction of railways, the improvement of river navigation, and other proceedings of a costly kind. Out of 3868 Swedish square miles, which Agardth estimates as the total area, lakes occupy one-eighth, or 498 Swedish square miles, fells and barren plains take up 1500, forests 1623, leaving only 247 for meadow and arable land. By degrees the cultivated portion will, no doubt, be considerably increased, but the climate opposes serious obstacles, and it is from her mines and her forests that Sweden must expect to obtain the means of purchasing food and comforts for her growing population.

A really good book upon this interesting and important country has been much wanted, and such a work could only be written by a shrewd observer, who had domesticated himself amongst the people, and become familiar, through a lengthened residence, with their language, customs, habits, and resources. Such a work the "Old Bushman" has produced, and we feel no hesitation in saying that, for some years to come, his *Ten Years in Sweden* will be an acknowledged authority, to which merchants, capitalists, naturalists,

* *Ten Years in Sweden;* being a Description of the Landscape, Climate, Domestic Life, Forests, Mines, Agriculture, Field Sports, and Fauna of Scandinavia. By "An Old Bushman," author of "Bush Wanderings in Australia," "A Spring and Summer in Lapland," etc. Groombridge.

sportsmen, and tourists will refer, and find stores of well-digested information, which bears evident marks of having been conscientiously collated and honestly given forth.

The season for visiting Sweden has now come. During the winter, with its short days and long dark nights, few travellers would wish themselves in a country not adapted to outdoor amusements, and which can only be tolerable to those who have opportunities of enjoying the hospitalities of its domestic life. In the northern parts the allowance of daylight becomes microscopic, and in the middle the "Old Bushman" describes the winter as dull and monotonous, "eighteen hours dark to six hours daylight, and it is often impossible to get into the forest for weeks, on account of the snow; and if you can, there is scarcely anything to shoot." If the weather is propitious, "the sledging is first-rate," and country houses are scenes of social gathering and festivity. In May a sudden change comes on. "A few dull, misty days, with warm wind and rain, and the whole face of the country changes, as if by magic. The green rye appears as the snow rapidly melts away," the wood anemone puts forth its blossoms, and trees suddenly burst into leaf. "Now all again is activity and bustle out of doors; animal as well as vegetable life, all at once wake up from their winter slumber, and for six months the farmer, sportsman, and naturalist have not a day to spare."

It must not, however, be supposed that the winter is an idle time for the natives. As soon as the ground becomes frozen in the autumn, the men of a forest district are off to their work. Their first proceeding is to dig a hole in the ground about ten feet deep, which has a cover built over, leaving a smoke-hole. This is the forester's hut, in which he lives, dining on herrings, cheese, and meal, which he brings with him. On Sundays he goes home, and on other days he fells the trees, and when the snow is hardened, and the ice on the lakes will bear weight, the timber is dragged along to the nearest stream capable of floating it down when the warm weather returns. The management of the forests is described as very wasteful, and in cutting the trees the woodman uses an axe, stands upright as he works, and strikes about four feet from the ground, so that much valuable timber is lost. The birch thrives well with the fir. It makes its appearance when the fir woods are cut down, and in young plantations it is valuable on account of its faster growth. At the age of ten it is hard enough for firewood, and at fifty it attains full growth. "As the birch trees are cut down, the more valuable trees are left. The birch thus pays for planting and pruning the better trees, which fatten the land, while the birch when planted alone impoverishes it." The pine takes a longer time to reach maturity, varying, according to the district, from 180 to 300 years. The "Old Bushman" supplies some curious facts and estimates concerning the age and dimensions of these trees. Thus, up the Tornea River—N. lat. 66° 40′—a pine with a diameter of $7\frac{1}{2}$ inches is reckoned to be about 100 years old; 11 inches, 150; and $13\frac{7}{8}$, 200. "So, according to these proportions, it appears that in this latitude a pine grows one inch in diameter in every ten years during the first

century, but in the second century, only one inch in every twenty-two years." At Gefle, which is a few degrees more south (60° 4′ N. lat.), the growth of pine is much quicker, reaching 14 inches diameter in about 100 years, 18½ inches in 150 years, and 23¼ inches in 200 years. In the middle of Sweden—N. lat. 59° 20′—a pine tree of 20 inches diameter at the root can be grown in 100 years, and it will be 100 feet high. At 20 feet from the ground, such a tree will have a diameter of 15 or 16 inches; thus, we see how much a little extra warmth and light will do for the promotion of timber growth.

In the proposals which are made to English capitalists to embark in Swedish enterprises, forest managing and timber cutting play an important part; and in many cases great mining enterprises are naturally and necessarily associated with these questions. On the whole we entertain a favourable opinion of the capacities of Sweden as a locality for investment, but to judge wisely of any particular project a great deal of information is required of a class that is usually suppressed in flourishing prospectuses; and we should strongly advise no one to invest a sixpence in such undertakings, without duly considering the various facts which the "Old Bushman" has so industriously collected. We do not doubt, for example, that the famous Gellivare district is one mass of possible wealth, but without offering any opinion on the projects of those who have undertaken to work it, a prudent speculator would require to know a great deal about the peculiarities of the climate, and the probable chances of inducing a sufficient population to settle in a district, that without the application of much skill and capital can only offer a partial subsistence to a miserable few. In considering these and many other important points, the work before us offers invaluable aid; and without intending a left-handed compliment to its author, we may say that his evidence is all the more trustworthy, because he has collected his information without having any speculative object in view. The climate and soil of Sweden forbid the gradual development that many other countries experience. Many large districts must remain uninhabited and worthless until a great change can be rapidly impressed upon them by associated enterprise; and provided judgment be exercised, a very great outlay upon a comprehensive scheme would offer reasonable chances of remuneration, while smaller though considerable disbursement on less complete plans would be sure to fail.

Seven-eighths of the Swedish people live in the country, and it has no cities that would be called large in comparison with our own; Stockholm having only 116,496 inhabitants, according to the census of 1861. Next comes Gothenburg, with 38,504 inhabitants; Norrköpping, with 20,228; Malmö with about as many, and no other exceeding 10,000. Greater possibilities of living by agriculture have caused the southern provinces to be ten times more populous than the northern ones, which can never support any considerable number except the mining and timber industries can be made to furnish enough money to purchase necessaries and conveniences that cannot be produced on the spot. "The timber crop," says our author, "is the true harvest of the north;" and to make the most

of it means of communication must be created that have no existence at present, and which could only pay by being carefully adapted to the requirements of mining districts. Swedish agriculture is stated to be improving, through the good practical education afforded in the farm schools established by the government; but dairy produce appears neglected, notwithstanding its ready sale.

The "Old Bushman" considers the present working of loan societies as unfortunate for agriculture. He complains that men not properly brought up to the business buy land with money borrowed from these institutions, and have not sufficient capital to work it. Such a state of things will probably cure itself, as there can be no inducement for men to engage in enterprises that fail to be remunerative. The failure of injudicious speculations of this kind, and the practical knowledge diffused by the farm schools, will cure the delusion that agriculture is a process in which ignorance and insufficient capital can succeed.

Rye is the principal grain crop in Sweden, and "most of the day-labourers are what they call *torpare*," that is, servants at will on the estate, who farm a bit of land, estimated at a high rental, and who work when required by their landlord, at a fixed sum per day. These men and their families are under what we should call a "truck system," being obliged to buy what they require at the landlord's shop, and until the country has made considerable progress, it is not likely that this class of trade will fall into independent hands, and be governed by the usual operation of commercial laws. A good labourer earns one shilling a day in Wermland, and female farm servants only receive £2 annual wages and their keep. For this delightful pittance these poor women are kept at constant work. "They never appear to know rest," and "if there is an hour to spare, there is always a spinning-jenny to sit down to." Part of their occupation is killing the calves and sheep!

The Swedish peasant has sturdy, sterling qualities, but, according to the "Old Bushman," "stingy past all belief," and constantly thinking of rix-dollars, of which, we apprehend, he does not see too many with all his care. A bad kind of brandy, called *branvin*, is one key to his heart, and tobacco another. He is also described as well-behaved and reliable, though not given to do things in a hurry, or change his plans. Altogether he is an estimable person, who deserves to share in the progress which we hope his countrymen are destined to make.

The arrangements for the relief of the poor in Sweden are very peculiar, and are reported to work better than might be supposed. No workhouse or Union receives the pauper class, and the poor rates are levied in grain. "Early in spring an auction is held, to which all aged and helpless paupers are brought, in order to be let for the year; each pauper is put up to a bidding, after the manner of a Dutch auction, to see who will take and keep him, or her, for a year at the lowest price, and a good deal of speculation often goes on among the assembled farmers. A helpless old pauper will be taken for eight tunna* of oats a year, and one with a little work left in him

* A tunna is little less than five bushels.

for less. The person hiring one of these unfortunates has to provide clothes as well as food, and they are usually well treated, as the Swede is naturally a kind master."

The ecclesiastical arrangements of Sweden differ from our own. The parishioners in certain cases choose their clergymen, and the clergy of a district choose their bishop. A curate begins with a stipend of about £10 and his keep, and his first living may be worth about £40 a year, the income being generally derived from a small farm, together with yearly payments of butter, etc., from the parishioners. Bishops are obtained as economically as parish clergymen, and even the Archbishop of Upsala, the Primate of the Swedish church, has an income of only £1200 a year. This moderate pay does not prevent the clergy from being held in high estimation, and they exert a powerful influence over the domestic life of all classes. Education is cheap in Sweden, and while the working men are better taught than our own, the middle-class have two good universities at Lund and Upsala, in which the total expenditure is from £3 to £4 per month.

With regard to the cost of living in Sweden, the "Old Bushman" remarks, that a man with a family, who cannot do without English comforts, can live as cheap at home; but, he adds, a sportsman can do well with £50 a year, if he hires a room and buys his own provisions; enjoying considerable facilities for obtaining various sorts of game. Ample details are given for those who contemplate a visit to the country, and it is evident that much enjoyment may be obtained at a moderate cost. In 1864 mutton was 4*d.* per lb., beef 3*d.*, pork 4*d.*, chickens 9*d.* each, eggs, 7*d.* per dozen in summer, oatmeal, 1*s.* for twenty pounds. The meat, except the mutton, is not praised, and the ordinary bread of the country would scarcely commend itself to English tastes. It is "made of hard rye, in thin cakes as large as a plate. This is hung up, and will keep any length of time. In some large houses they bake only twice a year; but they can also make just as good light wheat bread as in England." The last announcement carries consolation for travellers, as we think most of them—from this country at least—would be loth to interfere with the valuable keeping properties the native article is said to possess.

With many points of resemblance, the Swedes and the English have also marked differences in habit, partly, no doubt, resulting from the peculiarities of the climate in which the two nations live. Swedish boys are not fond of the athletic games that delight our youth, and their young men have no substitutes for the cricketing, boating, etc., that ours judiciously practise. With us winter is a season of physical activity for the well-to-do classes. In Sweden it is the reverse. The country gentleman has no hunting or shooting at that season, he rarely walks a mile, and the houses are made unwholesomely hot by stopping ventilation and heating the stoves.

We have in the preceding remarks afforded our readers a general outline of what a capital book the "Old Bushman" has made, and, as his matter is well arranged and condensed, he has contrived, in

less than six hundred pages, to present a great store of information on a variety of topics, and also to add what the naturalist will consider very valuable—a list of the mammalia, birds, and reptiles of Sweden, with descriptions of genera and species drawn from the best sources, and supplemented by observations which his own experience has supplied. The "Old Bushman" speaks very modestly of this portion of his labours. He says, "It is, in fact, a compilation from beginning to end; but, nevertheless, a compilation prepared with an immense deal of trouble, labour, and close attention. To take Nillson's *Fauna* in hand, and merely give a list of such animals as are met with in Scandinavia would have been a very simple affair, but to refer to the best authorities on the fauna of four large Northern countries, as well as of Great Britain, to compare them with each other, to see how far their observations tallied with my own experience, and then to pick out from all the best and shortest account of the different species, with its easiest and most reliable specific distinctions, was a work of no little labour."

We cannot doubt that naturalists will place a high estimate upon the perseverance and skill with which this portion of the work is carried out, and, in conclusion, we have only to commend the "Old Bushman's" record of his *Ten Years in Sweden* to all who, from whatever motive, or with whatever object, desire to obtain information on which they can rely.

ARCHÆOLOGIA.

The Archæological Institute has recently had under discussion a question of the greatest importance to every one who feels an interest in Archæology—that of TREASURE TROVE. It would not be easy to overstate the quantity of valuable antiquities which have been lost and destroyed through the operation of the law upon this subject as it now stands. According to mediæval principles, whatever was found without any clearly traced legal owner was held to belong to the king. Generally speaking, antiquities found buried in the ground had then very little acknowledged value; but this was not the case with money in times when it was scarce, and had a very high value in comparison with the ordinary articles which were purchased with it, or even with land itself. It has been from very early times the usual method of preserving money to bury it in the ground. A house, generally, was not a safe place, as it was liable to be entered and plundered by the numerous strong bands of robbers who infested every part of the land, town or country, and this was the case down to a recent period. The reader will remember the anxiety of Secretary Pepys, as he tells it in his diary, when, during the great fire of London, he buried his money in his own garden, and still more when, after the fire, he went to dig it up. In the same manner, the Romans, and the Saxons, and the Normans,

and, to a greater or less extent, all those who inhabited the land before Pepys' time, kept what they had of cash, more than enough for ordinary use, not in a strong box in a room in the house, from which it might be carried away, but by burying it either within the house, or in the yard or garden: for it must not be supposed that the hoards of ancient coins which are so frequently found in digging in fields, or roadsides, were merely placed in the earth in the open country. They lay no doubt originally within some building or inclosure, the traces of which have now disappeared. Life was then very uncertain, and the owners of these treasures were often cut off without leaving anybody acquainted with the place where their money was concealed, and it remained undisturbed until accidentally discovered in ages long subsequent. It is but natural for men who possessed landed property to look upon whatever they found in it as belonging rightly to themselves, and hence arose conflicting claims between moral right, or supposed moral right, and legal right, which, in times when people who were strong enough oftener committed it to the decision of force than to law, led to disastrous feuds and even to wars. It was well known how Richard Cœur de Lion met his death. Richard's feudal vassal, the Vicomte of Limoges, having found a treasure on his estates, sent a part of it to the king in the hope of appeasing him; but the latter, having been made acquainted with the circumstances of the case, claimed the whole, and, on the vicomte's refusal to surrender it, assembled some troops, marched against him, and, in an attack upon his castle, received his death-wound. In other instances, the law of treasure trove was made the instrument of vexatious acts of oppression and injustice. A curious case of this kind occurred in Ireland in the earlier half of the fourteenth century. A married man in the town of Kilkenny, who appears to have united the businesses of banker and usurer, buried his ready money within his house—we may suppose under the floor of his cellar. He was involved in a quarrel with some of his relatives, who had learnt somehow or other the circumstances of the burial of his money, and one day, during his absence from home, they broke into his house, dug up the money, and carried it away. Proceedings were, of course, commenced against them for the robbery, but, when the case appeared clearly to be going against them, they turned round, and pleaded that the money was treasure trove, because found buried in the earth, and that they were ready to give it up to the king, to whom it belonged. This brought an interruption to the original trial, and led to a new course of proceedings, which, in the then slow process of law, although the owner of the money could easily establish his right to it, tormented him for several years before it was decided.

These anecdotes will be sufficient to show the great inconveniences attending the law of treasure trove as a royalty. Like other royalties, such as the right to mines of the precious metals, it remained in the crown after the lands were given away, and could only be alienated by a special grant. The feudal barons, therefore, and especially the church and the ecclesiastical barons, laboured to obtain this special grant with their estates, and gradually the right of

treasure trove became very generally transferred from the crown to the lords of the manors. These seized upon the treasures found upon their estates, whenever they were worth the trouble, and nothing further was said about it, unless the find presented some remarkable characteristic. As lords of manors, even in recent times, rarely possessed any knowledge of archæology, and therefore took no interest in mere antiquities, and as stores of coins of any value for the metal only turned up at rare intervals, they took no care about the matter, and the law of treasure trove was allowed to remain a dead letter, except on particular occasions, when the value of the deposit, or the historical interest of the articles found, called their especial attention to it. The advantage thus derived from the law was merely nominal, while it was extensively injurious to the cause of science. The agricultural or other labourer who found a deposit of ancient coins or other antiquities, ignorant of their real value, yet knowing they were worth something, believed that he had morally a right to what he had found; at the same time, he knew that the lord of the manor had the law on his side and could take them from him, and that, moreover, he was liable to severe punishment for appropriating them. He, accordingly, concealed the discovery, sold the objects, when he could, to dealers, who gave him but a small part of their value, or to curiosity collectors, who gave him more; but, in either case, they were lost to science—the coins of gold or silver often went to the melting-pot, and the other objects were scattered, and in a short time destroyed, and at all events they were deprived of a great part of their historical value by being dissociated from the locality in which they were found. The loss which archæology has sustained from this state of things, since it has been cultivated as a science, is incalculable, and greatly to be lamented.

The subject was brought before the Archæological Institute, in a paper by Mr. Godfrey Faussett, who gave a sketch of the history of the law relating to treasure trove from the earliest period at which we have any information on the subject. The Roman law, he said, varied much in regard to the appropriation of treasure found without an owner. The Emperor Constantine adjudged it to the treasury, but, if it were brought in voluntarily, one-half was restored to the finder. Gratian vested the whole in the finder, but provided that, if the finder were not the owner of the soil, the latter should be entitled to one-quarter. This was acknowledging some right to treasure trove in what we should now call the lord of the manor. Valentinian II. gave the whole to the finder. This was changed again by Justinian, who ordered that treasure thus found should be divided equally between the landholder and the finder, and this appears to have remained afterwards the established Roman law. It was adopted in the Code Napoleon, and is still the practice in some countries. When we do find any regulations relating to treasure trove among the Anglo-Saxons, which is not before the reign of Edward the Confessor, treasure found in the earth was considered to belong entirely to the king, unless found in a church or cemetery, in which case the gold belonged to the king, and half the silver to the church, the other half to the king. Under the

Normans, treasure trove was altogether a royalty. The crime of concealing treasure thus found amounted to death, or loss of limb, which was at a later period commuted for fine or imprisonment. Mr. Faussett described the misapprehensions which had existed in regard to the law on this subject in modern times, and the proposals which had been made for amending it. In 1860, Sir George Cornewall Lewis, then Chancellor of the Exchequer, issued a well-known "circular" to the police, who were directed to claim all coins, gold or silver ornaments, and other relics found in this manner, for the crown, but to pay the finder their full value on his giving them up; and the circular further directed that, in cases of concealment which might come to the knowledge of the police, measures should be taken for the recovery of the treasure. This measure, as antiquaries know, has proved a complete failure, and only increased the difficulty it was intended to remove. Mr. Faussett seems to ascribe this in a great measure to the employment of the police, which he thinks was calculated to raise suspicion and ill-feeling; while, by asserting a claim to all ancient relics, and not to the precious metals only, the question became perplexed, and no intention was expressed as to the destination of the treasure which was to be delivered up. He offered some suggestions for the future arrangement of this question, which, at present, is certainly in a very unsatisfactory state. He is opposed to the opinions of those who wish the sovereign to waive all claim to the treasure trove, and vest the property of such discoveries entirely in the finders, because he thinks that this would be merely equivalent to an attempt to discourage pilfering, by giving the thief what he covets, and he thinks that this would benefit none of the parties concerned. He proposes an amended "circular," to the same effect as that of Sir George Lewis, with this especial difference, that the future destination of objects secured by Government should be distinctly set forth, accompanied with a well-defined statement of what the crown may and will claim, and the offer to purchase such objects as are not claimed, in addition to that of liberal and prompt remuneration for what it does claim; and he especially urges the elimination, as far as possible, of the police element in the transaction. In regard to this latter difficulty, Mr. Faussett suggests that, in some way or other, which we do not very clearly understand, the principal post-offices throughout the kingdom might be used as an agency in place of the police. Mr. Faussett's paper led to a long and rather warm discussion of the question, in which Mr. John Evans and some other speakers advocated the expediency of abandoning all claim on the part of the crown, or lords of manors, over treasure trove, as the best way of ensuring the proper preservation of the objects found. We confess ourselves much inclined to Mr. Evans's opinion. The real difficulty in all such plans as the "circular," or the proposed amended circular, arises from the circumstance that it necessarily implies a transaction between two ignorant people. The finders of antiquities in the country are usually agricultural labourers, who of course know nothing about them, and it will be a long time before the members of the police force or the men employed in country post-offices will have

become competent antiquaries. The only real effect of the law which creates a different claimant from the finder is to enforce concealment, which, of course, implies the loss of a great proportion of the objects found. It is generally a labourer who finds such object, while at work in the fields, or perhaps digging his own garden; he can see no reason why it should not be his own as much as the pebble he picks up and puts in his pocket, but he has an imperfect conviction that it has some value, and that he is liable to be deprived of it. He, therefore, keeps it from the knowledge of the people of the neighbourhood, until he meets with a stranger, who gives him perhaps a few pence for it, or he takes it to a neighbouring town, and sells it for an equally small sum. In either case, he conceals the place where it was found, or probably makes a false statement about it. This is the injury which archæological science sustains from the law relating to treasure trove, and the only effective remedy to be found for it is the spread of antiquarian tastes and antiquarian knowledge, and free trade in antiquities. There is hardly any corner of England at the present day where there are not two or three intelligent antiquaries in the neighbourhood who collect antiquities, or where there is not within a moderate distance a local museum. If the finders of antiquities felt assured that they were at full liberty to sell what they found openly, they would soon be in communication with these local antiquaries or with the curators of museums, and not only would the antiquities be preserved, but also the particulars of their discovery, in which, often, a great part of their value consists. It only requires the power of doing openly that which is now done in concealment.

Accounts of discoveries of CRANNOGES, or lake habitations, have been frequently reported of late in Scotland and Ireland. They are new objects of research, which, as might be expected, is fruitful in discoveries. They appear to belong not to an extremely remote period, for the oldest of them are not probably older than the late Roman period. One was lately traced in lowering the water of Grantstown lake, in Queen's County, Ireland; among the objects found in which were iron nails, with large heads, and other articles in metal, bone, and wood. Traces of crannoges are also stated to have been seen in Lough Neagh. Similar remains have been found in a lake under the glebe-house, in the parish of Aghnamullen, in the county of Monaghan, in connection with which a story is told, which we can hardly help suspecting of a little Irish imagination. The rector, sitting on the island, on the site of the crannoges, one day saw what he thought to be a button on the leaf of a water-plant, which had grown up from the bottom of the lake; but, on examination, it proved to be an old coin, a half-groat of King Edward III., "some of the treasures of the lake being thus lifted to the surface by the natural growth of the plant." No doubt some ingenious individual had picked up the coin and put it on the leaf, probably shortly before it so curiously attracted the rector's attention. To understand his more marvellous explanation of it, we must suppose that the leaf of the water-plant was fully developed in the bottom of the lake, beneath the surface where the coin lay,

and that the stem grew up gradually to the surface of the water, carrying with it the leaves thus developed from the bottom, which is not the usual process of the natural growth of plants.

Within a few months past, antiquaries in Scotland have been occupied in opening several early BARROWS and CAIRNS. In the centre of one of the latter, known by the name of Cairngreg, at Linlathen, in Forfarshire, a cist formed of large slabs of stone was found, from which, when this cairn was opened on a former occasion, a small urn and bronze dagger were taken. Between the two great slabs which covered the cist, one placed over the other, lay, what appeared to be, a fragment of a larger pillar, on which was rudely sculptured the figure of an elephant. This figure is said to be common on stone monuments on the north-east coast of Scotland, which belong to the Christian period; but, it was concluded, from the discovery of the urn and the bronze dagger, that this particular monument belongs to a much earlier date, and that, at the time when the cist was raised, the sculptured upright stone, which had been broken, was used in its construction, and that therefore the sculptures must be assigned to a pre-Christian system. This inference is, however, perhaps rather hasty, for if the sculptured elephant be characteristic in that district of very early Christian monuments, we should be inclined to look upon the sculptured fragment in the cairn to have quite as good a claim to be considered as evidence of the age of the latter as the urn and dagger.

At the last meeting of the Archæological Association, Mr. J. T. Irvine exhibited fragments of ROMAN TILES, taken from the old church at BERKELEY, in Gloucestershire, where they had been used as building materials. They afforded sufficient evidence that there had existed Roman buildings of some kind at this place, and, moreover, that it had been a military post, for these tiles were stamped with the inscription—

DECL.VI,

which was interpreted as standing for *decima cohors legionis sextæ*. If this interpretation be correct—for there appears to be some obscurity about it—it would point to a very remarkable circumstance. The sixth legion was stationed at York, as a check upon Scotland and the north, and is never, as far as we are aware, mentioned in any monuments in the middle or south of England; and why a body of troops should be brought from the legion at York into the remote district of Gloucestershire, where there was one legion close at hand (the second, at Caerleon) and another between Berkeley and York, and much nearer and more accessible (the twentieth, at Chester), is quite inexplicable. Is it possible that these bricks may be memorials of the late period, when, according to the Notitia, the twentieth legion was no longer in the island, and the second had been removed from Caerleon to Richborough in Kent, so that a portion of the only other legion then in Britain, the sixth, might have been employed in repressing disturbances, or resisting invasion in the south-west? T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

ZOOLOGICAL SOCIETY.

INTRODUCTION OF A LIVING PENGUIN, ETC.—At the recent meetings of this society, the addition of several new and very valuable animals to the collection has been announced by the secretary. Among these may be mentioned the three-banded armadillo, *Tolypeutes prœlatus*, described by Burmeister. This species is remarkable, as progressing on the tips of the very long and sharp-pointed claws of the fore feet.

The introduction of a living penguin into the menagerie is to be regarded as a circumstance of still higher importance, as it will enable naturalists to observe the habits and mode of life of this most singular group of fish-like birds. Hitherto all attempts to import these birds have failed, the animals always dying on the passage. The individual now living in the gardens is not the common species, the *Apterodytes demersa* of naturalists, the jackass penguin of the sailors, but the king penguin, *Apterodytes pennantii*. This more ornamented species is at once distinguished by the orange tint of the breast, and of the occipital feathers. In the penguin, every organ is modified so as to suit its aquatic habits; the sickle-shaped wings are perfectly useless in the air, hanging pendant by the sides of the upright body of the animal; in the water they become powerful paddles or fins, urging the progress of the bird with a sufficient degree of rapidity to enable it to hunt down and capture the fish on which it feeds. The legs and tarsi are extremely short, and are situated so far backward that the body of the bird is supported in a perfectly perpendicular attitude, the animal, when at rest, supporting itself on the two feet and the tail, as on a flattened tripod. The common penguin is described by Mr. Darwin and other naturalists as progressing on land on its breast, using its paddles or modified wings as fore legs. The specimen in the gardens does not seem to move in this manner, but walks or rather waddles on its webbed feet with very short and toddling steps. The specimen, which is placed in the pelican enclosure, to the left of the chief entrance to the gardens, is very tame, following the keeper for its food; the general appearance is that of considerable intelligence.

As very many years may elapse before another specimen of these birds is introduced into this country, the opportunity of examining this specimen should not be allowed to pass away unimproved by all who claim the title of Intellectual Observers.

MANCHESTER PHILOSOPHICAL SOCIETY.—*March* 7.

THE ACTION OF SEA WATER ON METALS.—Dr. Crace Calvert read an account of a very valuable series of experiments undertaken

to investigate the action of sea water on metals and alloys. It was found that when placed in a limited portion of water, iron, the metal now used so largely for ship-building, was attacked with the greatest rapidity, but that the action of the sea water upon it is materially lessened when it is coated with zinc, and that, therefore, it would repay ship-builders to have the iron galvanized—particularly as iron and oak timber, in contact, are prevented from exerting their mutually destructive action if the metal has been previously coated with zinc. As lead appears almost entirely unacted on by sea water at rest, it appears possible that it might be rendered available, although pure lead is far too soft to withstand the wear and tear to which ships' bottoms are subjected. In investigating the action of sea water on brasses of various compositions, Dr. Calvert spoke very favourably of the Muntz metal, which seems to owe its durability to the small proportion of lead and iron that it contains. In the discussion which ensued, Mr. Robinson stated that he had found an alloy of lead, tin, and antimony resisted the action of sea water better than any other alloy, or any pure metal that he had experimented with.

ENTOMOLOGICAL SOCIETY.—*April* 2.

Occurrence of Insects in Snow.—Mr. Pascoe, the president, stated, that when passing over the snowfield of Monte Moro, at an elevation of 8000 feet, during last July, he discovered several sharply defined cylindrical holes about an inch in depth, at the bottom of which was either a small mass of matter resembling peat in appearance, or, what was still more frequent, a dipterous or ichneumonideous insect. Mr. Pascoe explained their occurrence by supposing that the insects had alighted on the snow, and having become torpid, owing to the cold, had gradually sank into the snow, from the radiation of heat from their own bodies.

Recalling to mind the simple experiments of Franklin, to prove the varying amount cf absorption of solar heat by patches of different coloured cloths placed on snow, as measured by the depth to which the cloth melted the snow below it, it appears much more probable that the sinking of the insect into the snow was due to its becoming warm by the absorption of heat, and the consequent melting of the snow. On the other hand, the loss of heat by radiation would cause the snow to become more solid and firm.

ROYAL SOCIETY OF EDINBURGH.—*April* 3.

Economic Value of Food of Soldiers.—Dr. Lyon Playfair read a paper on the food of soldiers in war and peace. In this country, three quarters of a pound of meat and one pound of bread are issued daily to the troops, the rest of their food being furnished from their own pay. On investigating the total diet of nearly five hundred men, in garrison at Chatham, for twelve days, Dr. Playfair found that, stated in ounces and tenths, the returns were as follows:—

Flesh formers	5·1
Fat	2·9
Starch, etc.	22·2

This dietary closely resembles the war dietary of the continental armies, except that as potatoes are largely used in garrison, and not on active service, the starch and consequently the total carbon is increased. Dr. Playfair concludes that a war diet for soldiers should have at the very least a daily supply of five and a half ounces of flesh formers in the food, as this quantity is absolutely necessary to enable men to march fourteen miles daily, with a weight of sixty pounds of arms and accoutrements, without exhausting their own tissues to obtain the necessary amount of muscular force.

GEOLOGICAL SOCIETY.—*April* 5.

On the Chalk Districts of England.—Mr. Whitaker made several interesting valuable communications on the arrangements of the beds in the chalk districts. In the Isle of Thanet, a bed of comparatively flintless chalk overlies one with many flints. The higher division, or *Margate chalk*, contains but few scattered flint-nodules, and shows well-marked N.W. and S.E. joints. The lower division, or *Broadstairs chalk*, on the other hand, is less jointed, and has many continuous layers of flint. The beds form a very flat arch, as may be seen along the coast from Kingsgate to Pegwell, between which places the flinty chalk rises up from below that with few flints. It is remarkable that in this neighbourhood the Thanet beds are conformable to the chalk, the green coated nodular flints at the bottom of the former resting on a peculiar bed of tabular flint at the top of the latter. In carrying on the geological survey of Buckinghamshire, the Totternhoe stone (with its underlying chalky marl), which had been sometimes thought to be the representative of the Upper Greensand, was traced south-westwards into a part where that formation was fairly developed, and was then found to overlie it. The divisions of the chalk in Buckinghamshire are, in ascending order—

(1.) Chalk-marl, with stony layers here and there, and at top.
(2.) The Totternhoe stone, generally two layers of rather brownish sandy chalk, hard, with dark grains of small brown nodules.
(3.) Marly white chalk, without flints.
(4.) Hard-bedded white chalk without flints, forming generally a low ridge at the foot of the great escarpment.
(5.) The thick mass of white chalk without flints, or with a very few flints in the uppermost part, and at top.
(6.) The "chalk-rock," a thin hard bed or beds, with green-coated nodules.
(7.) The chalk with flint, the lowermost part only coming on near the top of the escarpment, the rest bed by bed over the tableland southwards, the angle of dip being rather more than that of the slope of the ground.

In the Isle of Wight, as in Oxfordshire, etc., the division between the chalk with flints and chalk without flints, is marked by a peculiar bed ("chalk-rock"), hard, of a cream-colour, and with irregular-shaped green-coated nodules, which may be seen in many of the pits on the southern flank of the chalk-ridge, where, however, it is very thin. Mr. Whitaker disagreed with the inference that the chalk was eroded before the deposition of the Tertiary beds, which has been drawn from the irregular junction of the two in the cliff-sections, and thought that the irregularity had been caused rather by the formation of "pipes" after the deposition of the latter, although he did not deny that there was other evidence of denudation of the chalk before the deposition of the Tertiaries upon it.

MICROSCOPICAL SOCIETY.

The annual *soirée* of this society was held on Wednesday, the 19th of April, and was very numerously attended. Messrs. Powell and Lealand exhibited one of their $\frac{1}{50}$ths, which attracted a great deal of attention, though the merits of such a remarkable objective cannot be adequately appreciated in a crowded assembly, in which the instrument is never free from vibrations. Mr. Ross and Messrs. Smith and Beck exhibited some fine objects, as did Messrs. Baker, How, Steward, Robbins, and a variety of other makers. Dr. Carpenter showed some remarkable specimens of *Eozoon Canadense*. Mr. Browning exhibited some spectroscopes, including the new direct vision pattern devised by Mr. Herschel. In the course of the evening Mr. How showed with a gas microscope a series of photographs of diatoms, etc., by Dr. Maddox. Many of them possessed great merit, but we think a better definition would have been obtained by lower magnification. He also exhibited in a similar way photographs of various animals.

The members of the society did not exhibit much, and we think on future occasions more pains should be taken to display a series of objects representing the principal novel microscopic facts of the year.

ROYAL ASTRONOMICAL SOCIETY.—*April 12th.*

Colonel Strange read a paper, "On an Aluminium Bronze Axis, and on certain new methods of Adjusting Transits." The author remarked that in November, 1862, he had before this society advocated the use of the new metallic alloy referred to, in the construction of astronomical instruments, and now some having been made, he could practically confirm the good opinion previously formed. One exception had been found to complete success, viz., that it did not answer for the graduated part of circles, as it tarnished rather rapidly; but other difficulties had yielded to scientific treatment, and the transit axis now exhibited and made by Messrs. Cooke was, notwithstanding its lightness and thinness of metal, probably the stiffest axis in existence. The axis was intended

for a 5-foot telescope, it was $33\frac{1}{2}$ inches between the bearings, the central tube was 9 inches in diameter and 0·15 inch thick, but strengthened by internal webs, and weighed only 56 pounds. The modifications in the adjustments related to three points: 1. The adjustments for azimuth and horizontality. 2. The application of the level. 3. The mode of collimation. 1. As to the raising and lowering the axis, and moving it in azimuth. These operations are generally effected by sliding parts, which are objectionable as they must be clamped, and this especially in the vertical slide produces great strain. It is proposed that a massive three-rayed piece of cast iron shall rest on each pier not fixed to it, but standing on three feet, with a central bolt to prevent accidental displacement. This will admit of expansion in all directions. The bearings in which the axis revolves rest on other three-armed pieces made of gun metal, and standing on the iron ones. The gun metal piece on one pier is acted on by screws having antagonistic motions, which shift the bearings in azimuth as required. The other gun metal three-armed piece has foot screws like a theodolite, for levelling the axis. It has a circular level which is first adjusted, and the screws are then moved as necessary, one of them having a lever apparatus, by which great delicacy of motion is obtained. No strain can exist under these arrangements, gravity being the only force called into action. An improvement has also been made in the bearings, the under surfaces of which constitute parts of spheres; and these work in cups, so that no amount of tilting will interfere with the points resting securely in their bearings. 2. As to the mode of applying the level to the axis. This is usually effected by a level striding from one point to the other, but such levelling cannot be performed with the telescope directed to the zenith where error of level is most injurious; and Mr. Cooke therefore proposes to have several levels attached to the telescope instead. There will be two near the central tube, and one at each end, all parallel to the axis. It is usually assumed that if the points are horizontal the telescope will describe a vertical curve; but this is not a certain inference; and it will be better to watch the centre, where any unsymmetrical flexure of the axis will be apparent, or any lateral deviation of the tube be made evident by the end levels. 3. As to testing the collimation error. It is intended in this instrument, which is a portable one made for the great Indian survey, to employ Benzenberg's method of observing the reflection of a wire cross in the eye-piece from a trough of mercury; and in order to avoid the vibrations of that fluid a plate of glass is to float on the metal, the under surface of which will form a brilliant mirror. Such plate ought to have two plane surfaces, parallel to each other, and the glass should be of uniform density. The first condition of a plane surface can be ensured by careful grinding; and should the other two not be obtained the reversal of the trough in azimuth, and observations in that position, would neutralise the error.

In an interesting discussion which followed the reading of the paper, Colonel Strange said the antagonistic screws of the azimuth

bearing were only used as a motive power and then released; that the levels being always attached would not run the risk of any jar in handling and placing on the pivots; and that he thought if the telescope described a true vertical curve the form of the joints was not so important as generally supposed, although he could still test them if necessary. The principal use of the instrument would be for obtaining the longitudes of the different stations of the survey (of which an arc of 10 degrees was now waiting for their determination) by electric telegraph signals, and the transit would remain one or two months at each station.

PROGRESS OF INVENTION.

New Method of Cementation.—In certain experiments made by M. L. Cailletet he found that cast iron, by long exposure to a temperature less than that which causes fusion, loses an amount of carbon which renders it very similar in constitution to steel. It differs, however, considerably from the latter, since it is forged with difficulty, and the bars obtained from it are incapable of being tempered. It is very brittle, and when broken resembles some kinds of oxide of manganese. Pursuing these researches further, he discovered that when bars of iron are heated for about twenty hours to a temperature somewhat under that at which gold melts, in contact with granulated grey cast iron, which has been carefully freed from all fatty matters and any adhering carbonaceous substances, in boxes from which the air is excluded, they are converted into steel of very good quality. They must be *in contact* with the cast iron, since, as was proved by experiment, their conversion is not due to the gases of the furnace having entered the boxes, those not in contact with the cast iron not being converted. This discovery is capable of being applied to a very practical purpose, since, if engraved and polished plates of wrought iron are used instead of the bars, they are cemented without suffering the least distortion, or even having their surface tarnished. Neither are blisters or other imperfections, so usual when steel is cemented with carbon, produced upon them.

Mode of Rendering Wood Plastic.—A new and very simple method of effecting this has been lately discovered. It consists in forcing dilute hydrochloric acid through the cells of the wood, at a pressure of about two atmospheres. This impregnation must be continued for a length of time, dependent on the nature of the wood. The bark is not previously removed, and by a very simple arrangement the fluid is introduced at one end of the log, and passes out at the other. If while the wood is still wet it is exposed to pressure, the cells having been first washed out with water, its volume may be reduced to a tenth of what it was originally; the fibres being brought into the closest contact, without being fractured or torn; and when dry they have no tendency to separate again. If it is pressed in dies, their details

are brought out with the greatest sharpness, and the most perfect accuracy. Impregnation in this way can be used for a variety of purposes. After the action of the hydrochloric acid, washing out with water, and drying, the wood may be cut with remarkable facility, and it answers admirably for the purposes of the carver. The drying is effected by forcing air, at a temperature of about 100° Fahr., through the cells. The moisture is thus carried off with great rapidity; and, as the contraction is uniform through the whole mass, no cracks are produced. Dyes also may be introduced in the same manner into the entire substance of the wood, or matters calculated to preserve it from decay. Soluble glass, or recently precipitated silex, renders it both very durable and thoroughly incombustible.

New Self-registering Thermometer. — This new maximum thermometer, which is of great simplicity, resembles the ordinary spirit thermometer, except that a small enlargement is blown on the stem, at about one-third of its length from the bulb. In this enlargement is placed a small globule of mercury, which, as long as the spirit continues to ascend in the stem, remains in its place, but when the spirit falls, descends along with it, dividing it into two portions, the upper one of which will continue nearly equal to the greatest distance to which the spirit reached above the enlargement. As that distance is easily measured on a scale, placed for the purpose, the maximum height which the temperature attained during a given interval, is easily found, no matter how low the temperature may have subsequently become. Heating the instrument until the globule of mercury reaches the enlargement, and then laying it on its side until it cools, prepares it for a new observation.

Utilization of South American Beef.—Sixteen years ago Liebig obtained the pure essence of meat, and demonstrated that it contains all the nutritive matter of the animal substance; but as, on the score of economy, there was no inducement to prepare it, its use has been nearly confined to invalids, to whom it is of the greatest benefit. It is exceedingly nutritious and very digestible, it hastens the recovery of strength in an astonishing way, and may be given in gastric fever and other diseases in which ordinary food cannot be digested. It is so agreeable that after their recovery patients continue to use it with pleasure, which is not the case with preparations of gelatine. The latter contain very little nutriment, and they soon become disagreeable to the palate. Eighty per cent. of the extract of meat is nutritive matter, but only four or five per cent. of the gelatine. According to the calculations of Liebig, one pound of the former, with bread, potatoes, and salt, would afford a meal to 128 persons. It may be kept for a very long time: Liebig found some he had prepared fifteen years before, perfectly fresh. In fact, it seems to possess antiseptic properties. A quantity of it, in pots, merely covered with paper, was stored in a damp cellar. Even the inside of the pots became mouldy, but there was no mould whatever on any part of them which was in contact with the extract. The latter is extremely portable, since one pound of it contains the nutritious matter of thirty-two pounds

of meat. If it is made poorer than this, or if it is attempted to adulterate it, it will not keep. All these excellent properties have not been able to bring it into general use, on account of its unavoidable dearness when made in Europe. But it seems likely that the preparation of it will very soon become the means of saving a vast amount of valuable meat, hitherto allowed to go almost entirely to waste, and thus add greatly to our supply of nutritious and agreeable food. Giebert, a German engineer, like thousands of others, was struck with the vast herds of cattle slaughtered in La Plata merely for their hides and tallow, the meat being abandoned from the impossibility of preserving it by the ordinary methods. But being, as it happened, aware of Liebig's experiments, the thought luckily occurred to him of extracting the nutriment from this meat on the large scale; and the undertaking is already so far advanced, that we may hope soon to derive advantage from it. The process required for obtaining the extract is very simple. The fresh beef is carefully separated from all fat, bone, and tendon—fat or gelatine would cause it soon to become rancid and mouldy; it is then chopped up, and placed with a small quantity of water in a water bath. According as any fatty matter or albuminous coagulation makes its appearance, it is removed. After some time the extract thus produced is poured off from the fibre, which now contains so little nutriment that it is quite incapable of supporting animal life, and is placed in earthen or other vessels. The latter do not require to be hermetically sealed in any way, and may indeed be closed in the manner usually adopted with preserves.

NOTES AND MEMORANDA.

Thermo-Electrics.—M. Bünsen finds that pyrolusite exceeds bismuth in thermo-electric power, and copper pyrites possess the same quality in a still higher degree.—*Pogg. Ann.*

The Leg of the Ostrich.—The Rev. Samuel Haughton, M.D., F.R.S., has a paper in the *Annals of Natural History* on the leg of the ostrich, founded upon the examination of a bird recently defunct in the Dublin Zoological Gardens. After giving a variety of important anatomical details, he observes, "in the act of running, the leg of the ostrich is to be regarded as a jointed lever, having four joints, the hip, the knee, the heel, and the metatarsal joints. As the animal springs from foot to foot, the whole limb on reaching the ground is bent as far as possible at each of these articulations; and, as the spring is made, the muscles proper to each joint increase the angle made by the bones uniting at the joint, so that the effect of the whole is to unbend the limb, and give it a maximum of extension at the moment of leaving the ground. During the spring the antagonist muscles again bend the joints, so that on next touching the ground it is at its maximum of flexion, again waiting to be unbent by the muscles that open the angles of the joint, and so on; as long as the animal runs, it is thrown alternately from each foot in contact with the ground as from a catapult, and advances by successive leaps or springs from foot to foot." Dr. Haughton also gives the calculations by which he arrives at the conclusion that "the force expended in propelling the body of the ostrich forward is ten times the force employed in restoring the legs of the animal preparatory to its next spring."

Supposed Composition of Nitrogen.—We have received a pamphlet by Mr. Henry Kilgour, in which he endeavours to establish the proposition that nitrogen is an allotropic form of carbonic oxide. He arrives at this conclusion

from some similarity of properties, from identity of atomic weights and combining volumes, and from their being approximately of the same specific gravity. Such facts as Mr. Kilgour adduces are well worth consideration; but they do no more than raise a presumption, to be confuted or confirmed by other considerations.

RESUSCITATION OF SNAILS.—*Cosmos* states that M. le Baron Aucapitaine has recently informed the *Société de Climatologie Algerienne*, that in 1858 he gathered specimens of *Helix lactea* apparently dead, and lying on the route between Touggourt and El Oued, exposed to a temperature of 50° to 55° C., or 122° to 131° F. It was said that no rain had fallen in this district for five years. In 1862 the baron discovered some of the snails at the bottom of a box, in a paper bag which had contained tobacco, and which was buried amongst books. He threw the snails into water, intending to clean them and present them to Commandant Lache, and was much surprised at finding them alive the next morning.

AQUEOUS SOLUTION OF ANILINE COLOURS.—M. Gauthier de Claurry has a paper in *Comptes Rendus* on the substitution of other substances for alcohol in the solution of dyes obtained from aniline and its congeners. He finds that gums, mucilages, soaps, especially almond, starches, including those from seaweed and lichens, particularly *fucus crispus*, glycerine, gelatine, etc., impart to water the property of dissolving these colours. The most advantageous substances are decoctions of the root of an Egyptian soapwort (*Gypsophila strutium*), or of a bark known in commerce as *Panama* (*Quillaia saponaria*).

PHOSPHORESCENCE OF THE SEA.—The Minister of Marine has transmitted to the French Academy a report from the commander of the "Augustin," which left Marseilles on the 7th March, 1864, for Pondicherry, and returned to the former place on Feb. 14, 1865. He says that on 1st Jan., 1865, being from 13° 30′ N. lat. and 30° 50′* W. long., to 17° 20′ N. lat., 33° 20′ W. long., a distance of about 275 miles, the sea was so phosphorescent that at night he could not distinguish the horizon. The light was bright blue, but in daytime the sea looked yellowish. The water contained a great number of little white threads, 4 or 5 millimetres long (about 15 to 19 hundredths of an inch), which assumed an ovoid form, after remaining for some hours in a glass, 3 millimetres long, and half a millimetre thick, "in the midst of which a ring was formed, which diminished their thickness by half." Gradually these objects soldered themselves together in groups of 12 to 15, "making a kind of worm" of a bright grey tint. Some hours later a yellow spot and some bright orange spots were seen at the ring, and the creatures then looked like some he had seen at various places, and particularly at St. Helena, and which were known as *frai de poisson*, or *frai de baleine*.

NATURE OF YEAST.—M. Hoffmann, of Giessen, has sent a paper to the French Academy on this subject. He says that wort, after a sufficiently prolonged ebullition, neither ferments or gives rise to any organisms by mere contact with air, provided no atmospheric dust is admitted. Beer yeast gives rise to the *Penicillium glaucum*, or blue mould, while baker's yeast, from brandy distilleries, either produces that plant alone, or the *Mucor racemosus* in conjunction with it. By sowing the spores of these plants in sugar solution, he obtains a fresh crop of yeast.

THE PENGUIN AT THE ZOOLOGICAL GARDENS.—This bird is a most interesting addition to the collection of the Zoological Society. Its colours are much handsomer than are shown in stuffed specimens, and its attitude and upright mode of walking, or rather waddling, are remarkably grotesque. Although in its natural condition it passes a great portion of its life in the water, it manifests no disposition to swim in the little pond provided for it, but much enjoys a shower-bath, frequently administered with a garden syringe, terminating in a fine rose. It is very tame and good-natured. The wings are reduced to mere flappers, covered with extremely short, close-set feathers, and the pupil of the eye is often seen contracted to a minute spot. It feeds freely upon fish, taking several meals a-day, judiciously regulated as to quantity.

EXPERIMENTAL PROOF OF THE IDENTITY OF HEAT AND LIGHT.—Whatever conviction may have been entertained hitherto as to heat and light being merely

* According to French reckoning, our first meridian at Greenwich is + 0h. 9m. 21s.

modifications of the same thing, it could scarcely be considered as demonstrable by experiment. Professor Tyndall has, however, now succeeded in doing this. He was led to the important results he has attained by the discovery, a few years since, of a medium perfectly pervious to radiant heat, but at the same time perfectly opaque to light. To effect the change of heat into light he obtains a cone of convergent rays by concentrating the rays of the electric light with a small mirror, and then intercepts all those which are luminous by an opaque solution of iodine in bisulphide of carbon, which allows all the calorific rays to pass on to a focus. The latter, even in a darkened room, is completely invisible; but any combustible substance placed within it is immediately inflamed, as described in our number for March, p. 161. If this combustible is zinc, or magnesium, for example, the light produced is intensely brilliant. To render it impossible that its luminous character should be due to the process of combustion, platinum was thus heated *in vacuo*, and the light emitted produced a perfect spectrum. The invisible picture of the charcoal points, so to speak, was changed into a visible by decreasing the refrangibility of the rays—that is, by transformation of the heat into light; and every change made in the position of these points was distinctly perceptible on the platinum. This may be looked upon as the completion of what was begun thirteen years ago by Professor Stokes. The latter rendered the ultra-violet rays visible by diminishing their refrangibility; Professor Tyndall has rendered the invisible rays belonging to the opposite extremity of the spectrum visible by increasing theirs. A similar proof of the identity of light and heat was, indeed, suggested by Aikin at the meeting of the British Association in 1863; but he proposed to use sun light, and has not as yet been successful, though he employs a mirror three feet in diameter. Professor Tyndall, by using the electric light, attained his object, and with the use of a mirror only four inches in diameter.

The Microscope and Spectroscope Combined.—Mr. Sorby places a small prism beneath an achromatic condenser, and allows light to fall upon it through a slit placed at a certain distance in front of a lamp. Exceedingly dilute solutions of blood and certain other substances being interposed, produce the dark bands discovered by Professor Stokes, and when the spectrum is viewed through the microscope, with a low power, they are readily seen. Mr. Browning has carried out Mr. Sorby's idea in a very neat and convenient way; but we doubt whether the intervention of a microscope will prove to be the most advantageous mode of viewing very delicate absorption bands. We made some experiments at Mr. Browning's, which suggest the correctness of this view. First we reduced by further dilution a *very* weak solution of blood in water, until the absorptive action on the prismatic spectrum was very faintly seen under the microscope. The solution was then examined by a large and fine single prism spectroscope, having considerable dispersion, and no absorption band could be seen. Mr. Browning at once suggested the true cause, viz., too much dispersion. A smaller spectroscope, with less dispersive power, was then tried, and the absorptive action at once became visible. It is evident that while the separation of closely adjacent lines in spectra can only be affected by considerable dispersion, a large amount of that kind of action thins out, and renders invisible, very delicate absorption bands. A spectroscope to show such bands should have such an angle as to produce little dispersion, and the spectrum should be viewed with slight magnification, or with none at all.

Light Streaks in the Crisian Sea.—Mr. Slack states that on the 2nd of April, in the evening, when the moon was about 6 days 14 hours old, the Crisian Sea presented an unusual appearance, being striped with delicate bands of light radiating from the vicinity of a small mountain near Picard. Several light spots were also noticed in parts of the same sea, which are usually dark. Mr. Slack inquires whether other observers noticed these appearances.

THE INTELLECTUAL OBSERVER.

JUNE, 1865.

EGYPTIAN VILLAGE LIFE.

BY F. W. FAIRHOLT, F.S.A.

(*With a Coloured Plate.*)

Persons who only know the East through the glowing pages of the poet and romancist, and who consequently believe it to be entirely composed of sunshine, birds, flowers, palm-trees, and poetry, would be greatly surprised, on taking the prosaic view of the realities of life, that would be forced upon their notice wherever they went as travellers. Crabbe has for ever destroyed the romance of English village life by his stern and truthful pictures of its privations; but that of Egypt may be said to resemble the worst phases our own would exhibit deprived of a poor-law, or the least honest government.

Few persons look beyond the surface of things, and very many travellers delight in dressing up their narratives according to their own notions, taking only such facts as please themselves, or prop their preconceived theories, and persistently ignoring all others. In this way we obtain delightful books, utterly untrue. Equally blameable are others, belonging to the school of detraction, who have eyes only for evil. In both instances there is truth as a foundation for all; but bane and antidote are not together, hence the two travellers can scarcely be believed as describing the same thing. While drifting down the Nile, the author endeavoured to embody these two styles of narrative, as "a written picture" of a village he had just visited, and in the hope of amusing the reader they are here transcribed:—

AN EVENING IN EGYPT.—(*Couleur-de-rose.*)

The evening closed in, and our excellent captain prepared to make all snug for the night in a charming spot, near a village sheltered by groves of date-palms. Here the playful eddies of the ever-flowing Nile had formed a small bay, in

which our vessel rested peacefully. The high bank, broken into picturesque form by the fall of the rich earth of which it was composed, testified its priceless agricultural value; it was diversified by groups of villagers, who had come forth to greet with smiles the boat of the stranger from afar. Their figures were grand in their simplicity; their slight clothing had never impeded the free action of every limb; its coarse texture gave breadth and boldness to every fold as the parting gleams of sunlight fell full upon them. Young mothers modestly sat by the doors of their picturesque mud-cabins, shrouding their features with a native grace from the glance of the male stranger, but unable to hide the clear and lustrous eye that sparkled beneath the blue head-dress, and beamed with fondness on the infant nestling in the folds of her ample robe, for no clothing impeded the free movements of these children of nature. Thus were nurtured the muscular men who stood by them, and such had been the healthy and venerable patriarchs who sat and smoked their evening pipes in the shadow of their native village. From the humble roofs of many cabins a graceful curl of silvery smoke told of the frugal meal preparing at the close of day. The sun was setting amid gorgeous hues, and a light wind playing coquettishly with the tall and graceful palm-trees, waved them grandly in the air, as if bidding farewell to the sun, as he sank behind the western hills, and gilded with his parting rays the solemn desert beyond.

THE SAME.—(*Couleur-de-jaune.*)

Night was approaching, and the captain of our boat, whose obstinacy gave us frequent reason for just complaint, anchored the vessel in the very centre of a dirty village, a position to be carefully avoided by all travellers on the Nile. The current had washed a semicircular hole in the side of a steep bank, and under pretence of its shelter we were doomed to pass the night in a sort of mud puddle, where all the filthy rags of the dirty people were washed, when ablution became a necessity with them. A steep, broken bank of mud was all that met the eye, on the summit of which crouched many of the half-civilized inhabitants of the place, dressed in rags that neither served for warmth or concealment. Wretched women crouched at their doors, pretentiously hiding faces that are squalid when young, and hideous when old; miserable naked children nestled in their ragged robes; muscular men, of sinister aspect, showed the effect of this early nurture; and dirty elders, in whom age ceased to be venerable, sat in heaps of congenial dirt, telling unpleasant truths to the observant of what the romantic call "pastoral simplicity." A dense smoke

ascended from the cabins, casting out an intolerable stench, the fuel being cakes of dried camel's dung, and added to the abominations accumulated in every corner, as if traps for pestilence had been purposely set by this degraded race. The sun set behind with a lurid glare, as if in anger, and the palm-trees waved like the feathers of a hearse over departed greatness, as the wind sighed hot and heavy amid their branches, and told of suffocating aridity in the bordering desert.

It must be in a better spirit that we look upon the Egyptian villager. To invest his position with "the poetry of the East" would be an absurd falsity, to dwell entirely on his discomfort would be to complete a picture of wrong and hopeless misery. The evil of many taskmasters and irresponsible tyrants infesting every place of government, from lowest to highest, make his life one long struggle against evil influences, and teach him craft and dishonesty as weapons of self-defence. The chief man, or Sheikh, of a village, curries favour with the local governor of his district by aiding his extortion, or supporting his tyranny. An appeal to a legal tribunal is useless without a bribe to the judge; and should an opponent's bribe be heaviest, he wins as a matter of course. The Pasha of Egypt himself is considered fair game for plunder by every local pasha beneath him; nor is this to be wondered at, when he is broadly accused of seizing, at his own will and pleasure, land and other property, on any pretence. To covet his neighbour's goods is but the preliminary step to taking them, according to the current report of his people, sometimes under the colourable pretext of purchase or exchange. But such pretexts deceive nobody, and go for nothing in the estimation of those most immediately concerned in them, who barely listen to such transparent fallacies.

The effect of such an evil system is everywhere visible in Egypt. In a land so wondrously blest by nature, whose soil is the very perfection of fertility, the European cannot but feel how different its people would become under just laws, and a government they could trust in, for due justice, or common honesty. The germ of the glory and power of ancient Egypt lies still in its soil, dormant for many ages, but not dead. The people are energetic, nay, anxious to improve; the greed of gain is as strong with them as with any people, but their powers are restrained by their poverty, and they are still more crippled by the rapacity of dishonest governors. Why should they work, against nature, in a climate where rest is felicity, where nature requires very little, and where industry is rewarded by plundering it of its gains?

Wondrous is the soil of this grand old country; scratch but

its surface and the seed will grow. Nature's bounty is in no part of the world more visible than in the valley of the Nile. A narrow strip of land on each side the river is bounded by the arid desert, where nothing but the Bedouin can live. Where the river overflows, and the mud settles, there vegetation thrives; and so clearly is the line marked that it is possible for a man to place one foot on the rich and fertile soil, and the other on the hot desert sand.

The plough used by the peasantry is a pointed beam of wood, just dragged through the surface soil, deep enough to give a bed to the grain. The wildest weeds, with us, do not grow more luxuriantly than the corn, the lentil, and the tobacco-plant does with them. Everywhere nature laughs, while man sighs over governmental maladministration.

The farmer suffers from extortionate tax-collectors, or thieving pashas; the *fellah,* or husbandmen, and the poor peasant, have deeper griefs; they are liable to be torn from their homes at any hour, by conscription, for the army, and a happy and prospering family may be suddenly reduced to beggary and want by the loss of its necessary master. Cruel are the consequences this has brought about; poor women, with the feeling that their weakness must make a strength out of their necessities, have endeavoured to nullify a fate that hangs over their offspring, and have not scrupled to put out one eye of an infant, or cut away the joint from its forefinger, to prevent the dreaded conscription in after life. This, and ophthalmia, have made more one-eyed men in Egypt than could be found in the same space in any other part of the globe. A fair average of the number of men maimed in the right hand may be gained by reckoning only such as formed the crew of the boat in which the author travelled—it was six out of fourteen, but the others not exempt in this way had but one eye, or had lost the front teeth, of which they had been deprived to hinder them from being able to bite cartridges.

The peasant is also liable to a conscription for labouring purposes, ordered by the local government. He may be taken from the necessary labour of his field or farm to construct dykes, or other works thought necessary. For this he has no pay, and is very hardly worked. When the late Pasha determined on the formation of the Mahmoudie canal, connecting Cairo with the Nile, he formed it by this forced labour. Poor men were torn from their homes, compelled to dig the basin of the canal with any tools they had; the government helped them in no way, not so much as a spade was given to any one, no food provided for them, and no pay. With frantic desperation, the starving creatures scratched at the earth with their fingers, and died by thousands in the trenches.

The world's history can scarcely parallel that of the Mahmoudie canal.

Let us turn to the brighter side, happily it is there in spite of "man's cruelty to man." Affection is the poor man's wealth, the love that can be so strong as to induce an Egyptian mother to maim her child that she may keep him near her, is above all evil governmental influence. Easily made happy in a climate where existence is a pleasure, having few wants to be satisfied, with an eager desire to convert the simplest good into a great benefit, a child-like enjoyment is felt, even by the aged, who have had so much cruel worldly experience. This it is that surprises the European, and the Englishman especially, who delights so thoroughly in depreciating "the good the gods provide him." The faces of these poor people lit up by the gift of a loaf of bread, an orange, or a few halfpence, may furnish a useful lesson to some of the London sybarites who now travel on the Nile.

The cottages are constructed of clay, or built of clay bricks, dried in the sun, and which, in this dry climate, will last for centuries. The mud of the Nile is a very tenacious slime, and the deposit laid every year by the overflow of the river, bakes into thin layers under the hot sun, so that the age of the banks may be reckoned as you may count the age of a tree by the examination of the succeeding layers of bark. The houses are comfortless hovels, devoid of all furniture but that required for cooking. The larger houses have their upper rooms furnished with raised divans, or seats of palm-branch, upon which carpets are spread. Windows are small, for light brings heat, which is to be especially guarded against. The roof of the house is the place where in the evening the family delight to congregate, and often sleep during the night. Some of these houses are made especially gay by rude painting, as shown in the engraving which accompanies this paper. The style of this decoration is evidently traditional, remaining with the people from the most ancient time. It resembles portions of the wall-painting at Beni-Hassan, and other places, where we see the most primitive forms. The houses thus especially decorated are those of such persons as have performed the pilgrimage to Mecca. When a hadji returns, his neighbours help in ornamenting the surface of his dwelling with red, white, and blue washes, in patterns bounded by broad black outlines. The beam over the door has its wooden surface painted still more delicately, but in the same taste, and a circular ornament is usually painted above; sometimes this ornament is a Moorish tile in vitrified tints, but the author was once surprised at finding a plate of the famed old English "willow pattern" inserted over a doorway.

Two distinctive features obtrude themselves on the stranger's notice in an Egyptian village. One consists of the groups of savage wolf-dogs who combine to attack them, but who are equally troublesome to the native who approaches a strange house. The other is the vast flocks of pigeons, whose homes are often in the upper floors of the houses, built high in consequence, with square turrets that give a simple village the look of a fortification. The birds fly far, and forage all day, returning to their houses at sunset in such incredible numbers that it seems wonderful how a farmer can rear a crop subject to their depredations only, yet he has also to feed the wild birds, who are equally abundant. The valley of the Nile literally teems with ornithological life. Like the showman's lions, it "must be seen to be believed."

What will be the future of this prolific Egypt? After many centuries of neglect and decay, will it again arise, and assert its undoubted right to eminence? Is all this native fertility to go for nothing in a world of enterprise? is Monsieur Lesseps and his problematical canal to be the end of western pressure? or is France to point the way to Egyptian emancipation. Already England has made a railroad to Cairo, and conquered the difficulties of the desert route to the Red Sea. We have forced upon the people a knowledge of the mode of making wealth. Our demand for cotton has met with a ready response, the railway is besieged with camels heavily laden therewith; on the banks of the Nile, cotton and sugar mills everywhere appear. The people are willing, if the government can give a guarantee of its good faith; everything depends on that. With European rule, and honest taxation, all would go well; the Nile would again flow through a superabundant garden, inhabited by a prosperous and happy people. When will "the sick man" die, and who is to take his place? Upon the solution of that question depends the greatness of the future.

NORTH POLAR EXPLORATION.

BY CLEMENTS R. MARKHAM.

Voyages of discovery have been, since the dawn of modern times, one of the chief causes of the rise of England's power and greatness. The material wealth which they have been the means of pouring into her lap is incalculable. For this alone they will ever be a leading feature in the history of a mighty commercial nation; for this alone they have been fitted out by many a merchant adventurer; and for this they have been incessantly urged upon the attention of many successive Governments. But it is not on account of the commercial advantages that have been derived from the labours of the explorer that those labours are to be most prized, seeing that it is not to wealth alone that England owes her greatness. Exploring expeditions by sea and land have done as much to increase the store of human knowledge as any other kind of research. They have led the way to the creation of that colonial empire, which has spread the Anglo-Saxon dominion far and wide over the earth. They have fostered the spirit of enterprise, and formed a nursery for the pick of our seamen. They have been a school for our best officers, educating them in that calm self-reliance which the presence of danger alone can give. They have been most important agents of civilization, creating a brotherly feeling of sympathy between the nations in times of peace, and giving one bright side even to the horrors of war, for, by the courtesy of international law, a scientific expedition is respected by all civilized nations.

Seeing, then, that expeditions of discovery have helped so largely to make England what she is, it is no less a matter of surprise than of regret that any proposal to continue them, and to complete work which it is the glory of this country to have commenced, should meet with unreasoning opposition from any influential quarter. Surely it cannot be desirable to close the brightest page of our history for ever, for the purpose of saving a little money, or in order not to risk the lives of men whose value to their country arises from the education they acquire by that very process. The grand saying of good Sir Humphrey Gilbert, when advocating an expedition to the Arctic regions, can never be too often repeated:—"He is not worthy to live at all, who, for fear or danger of death, shunneth his country's service or his own honour, since death is inevitable, and the fame of virtue immortal."

Let it once be shown that an expedition of discovery will

add to the sum of human knowledge, that it will lead to valuable scientific results, and that there is no chance of the men who compose it being overtaken by a catastrophe such as that which befel Sir John Franklin's people, and it ought to receive cordial support from public opinion. The collateral advantages that are derived from such expeditions in times of peace are so great that they will be felt by every thinking man. All men may not fully appreciate the value of scientific researches, but no true Englishman can under-estimate the importance of fostering the spirit of enterprise in his countrymen, or fail to desire that the race of men, from Cabot to M'Clintock, which has been formed by expeditions of discovery, should be continued.

What would the glorious reign of Elizabeth be if the stories of Raleigh and Drake, of Frobisher and Fenton, of Richard Hawkins and Grenville, and Gilbert were blotted out? The very name of James I. would fill us with shame, if those of Hudson, Davis, and Baffin were not written in the same page of history. Even the disgrace of having been ruled by his grandsons is slightly mitigated when we find them sending Captain Wood to seek for the North Pole. The readiness with which the statesmen of the last century complied with the suggestions of the Royal Society to send out exploring expeditions wipes away a multitude of sins, and we may condone many acts of misgovernment in consideration of the voyages of Carteret, Byron, Cook, Phipps, and Vancouver. It must never be forgotten that Nelson received no unimportant part of his naval education in the Arctic regions; and that, in the present century, the surveyors and explorers of our navy have been among its brightest ornaments.

The naval enterprise of Great Britain has assuredly been one of the chief sources of her greatness, and it is for the advantage of the country that the spirit which gives rise to it should be fostered and encouraged. Never has this spirit been so systematically ignored, in any period of our history, as at the present moment. Not only is there no exploring expedition engaged in any part of the world, but the most necessary surveys have been starved and neglected. The important proposal to explore the North Polar region, which has recently been made by Captain Sherard Osborn, therefore, comes before us at the very time when its discussion is likely to produce much good, and it certainly deserves most serious and attentive consideration.

I propose, after giving a very brief sketch of the history of the subject, to examine the question whether Captain Osborn's proposal combines those conditions which would justify its favourable consideration by the Government—

namely, sufficiently important results, and the absence of any chance of such a disaster as overwhelmed the Franklin expedition. The great advantages that are invariably derived from enterprises of this nature, independently of their more obvious results, have already been pointed out.

It has been the ambition of British explorers to reach the North Pole ever since "Master Robert Thorn exhorted King Henry VIII., with very weighty and substantial reasons, to set forth a discovery" for that purpose; and as knowledge has accumulated, these reasons have become more weighty and more substantial. Bluff King Hal did not haggle at the expense, nor did he discourage the spirit of enterprise among his sailors. He did the right thing, cordially acceded to the proposal, and sent "two faire ships well manned and victualled, having in them divers cunning men to seek strange regions.* Subsequent voyages to the northern seas in the Tudor age, opened a profitable trade with the then scarcely known duchy of Muscovy; but the most notable expedition of the sixteenth century was that which was led by gallant William Barenton, and his stout crew of Dutchmen. He discovered Spitzbergen in 1596, rounded the northern extreme of Nova Zembla, and performed one of the most remarkable Arctic voyages on record.

In England the merchants of the Muscovy Company were the great promoters of voyages towards the Pole, and as the introducers of the system of keeping log-books, they ensured the preservation of a record of the results of those voyages.† In 1607 they sent bold Henry Hudson, in an eighty-ton vessel, with ten men and a boy, to sail across the North Pole. He discovered the point on the coast of Greenland which still bears his name of "Hold with Hope," traced the ice barrier extending right across from Greenland to Spitzbergen in June; and the name of Hakluyt Head, the extreme N.W. point of Spitzbergen, was also given by Hudson. Having thus satisfied himself of the impossibility of penetrating through the Polar pack to the westward of Spitzbergen, this intrepid explorer next sailed up to its northern end, and examined the condition of the ice in that direction during the month of July. He attained a latitude of 80° 23′; and having ascertained that the pack was as impenetrable in the end of July as it was in June, he returned to England. In 1608 Hudson again sailed with the intention of attempting to effect a passage between Spitzbergen and Nova Zembla, and thus completing the examination of

* *Hakluyt*, iii., p. 129.

† Sebastian Cabot, in his instructions to Willoughby and Chancellor, was the real originator of the log-book.

this, the widest opening into the Polar region. He had with him a crew of fourteen men. On the 9th of June he came to the edge of the pack, in latitude 75° 29′ N., and gallantly attempted to push through it, "loosing for one piece, and bearing roome for another." But he soon discovered that this sailing ice only existed at the outer edge, and in four hours he found the pack to be so thick and firm ahead, as to present an impenetrable barrier. He therefore began to coast along the pack edge, with the ice always "trending on his larboard" from the 9th until the 26th, when he sighted the coast of Nova Zembla.* During this voyage Hudson discovered the Gulf-stream flowing northwards, with divers pieces of drift wood floating on it. This intrepid seaman had now completed the examination of the space between Greenland and Nova Zembla, in two very small yachts; and he had ascertained beyond a doubt, by careful inspection, that an impenetrable barrier of ice stretched along the whole distance, barring the passage to the Pole. He found that on the Greenland coast this barrier came down as low as 75°, that it thence trended to the N.E., until in the meridian of Spitzbergen its outer edge was north of 80°; and that further east it extended south again to about 75°, and stretched away to the coast of Nova Zembla. Thus, "by the means of the great plenty of ice, the hope of passage between Newland (Spitzbergen) and Nova Zembla was taken away."

In 1611, Jonas Poole, and in 1614-15, Baffin and Fotherby, made similar unsuccessful attempts in the direction of Spitzbergen, and in 1676, the Admiralty of Charles II. sent Captain Wood to attempt a passage to the North Pole, but he lost his ship on the Nova Zembla coast. This important and interesting subject was then lost sight of in England for nearly a century, from the time of Wood (1676) to that of Phipps (1774). It was quite clear that for Hudson's cock-boat, and such like craft, the portals of the unknown region were firmly closed. It remains to be seen whether a sharp-bowed screw-steamer will be able to force them open.

The Spitzbergen Seas, however, were a favourite Dutch and English whaling station during the whole of that time, and vessels frequently reached a latitude of 80°, and sometimes of

* On the 15th of June two of his company, named Thomas Hilles and Robert Rayner, saw a mermaid close to the ship's side, and looking earnestly upon them; but a little after, a sea came and overturned her. From the navel upwards her back and breasts were like a woman's, her body as big as one of us, her skin very white, and long hair hanging down behind, of colour black. In her going down they saw her tail, which was like the tail of a porpoise, and speckled like a mackerel. Hudson's editor suggests that this was a seal, and adds the testimony of Dr. Kane, that there is something in the appearance and movements of this animal strongly akin to those of human beings.

81° or 82°, or even 83°,* as the position of the Polar pack varied in the different seasons. When the idea of an expedition to the North Pole was again mooted in the last century, Mr. Daines Barrington, a Fellow of the Royal Society, with great industry and perseverance, collected a number of stories of whalers having frequently attained incredibly high latitudes, and as these fables have since been brought forward as arguments in favour of a Spitzbergen route to the Pole, it will be as well to examine what they are really worth.

The most marvellous of all is that told by Master Joseph Moxon, hydrographer to the King's most excellent Majesty, in 1697. He got most outrageously chaffed by some merry Dutch sailors in a beer-shop at Amsterdam, and gravely published what he had been told,† expecting every "sober, ingenious man" to believe it. Scoresby has pointed out that the instances of voyages having been performed beyond 84°, are in no case given from the direct communications of the voyagers themselves, and he therefore infers that no reliance whatever is to be placed upon these extraordinary instances.‡ Moreover, he finds that nearly all the cases of ships having sailed as far as 82° and 83°, were either given from memory, at a distance of eighteen to thirty years from the time when the alleged voyages were made, or at second-hand. But the strongest proof of the small reliance to be placed on the observations of these whaling captains is to be found in the statements of Captains Robinson, Clarke, and Bateson, who declared they reached 81° 16′, 81° 30′, and 82° 15′, with open water before them, in the very year, and in the same longitude that Captain Phipps was stopped in 80° 48′ N., by a continued smooth, unbroken plain of ice extending to the horizon.

* Parry thought that a vessel might have reached to 83° N. in 1827.

† *A Brief Discourse of a Passage by the North Pole to Japan and China.* By Joseph Moxon, F.R.S., Hydrographer to the King's most excellent Majesty (2nd edition). London, printed by J. Moxon, and sold at his shop at the Atlas in Warwick Lane, 1697.

He says, "About 22 years ago, being in Amsterdam, I went into a drinking house to drink a cup of beer for my thirst, and sitting by the public fire among several people, there happened a seaman to come in, who, seeing a friend of his there who he knew went in the Greenland voyage, wondered to see him, because it was not yet time for the Greenland fleet to come home. His friend, who was a steersman, said that his ship sailed into the North Pole and came back again. I entered into discourse with him, and he did assure me it was true; and told me, moreover, that they sailed two degrees beyond the Pole. I asked him if he found no islands or lands about the Pole, and he told me no, there was a free and open sea. I asked him if they did not meet with a great deal of ice. He told me no, they saw no ice. I asked him what weather they had there. He told me fine warm weather, such as was at Amsterdam in the summer time, and as hot. I should have asked him more questions, but he was engaged in discourse with his friend, and I could not in modesty interrupt them further. I believe he spoke truth, for he seemed a plain, honest, and unaffectatious person."

‡ Scoresby's *Arctic Regions*, i. p. 42.

When Mr. Barrington asked the Dutch skippers themselves, he got the simple truth from them; they said, "We can seldom proceed much higher than 80½°, but almost always to that latitude."* Captain Jansen, of the Dutch Navy, also says, "I do not think our Polar navigators have been further north than 82°."† There is not, in reality, a shadow of evidence that any vessel has ever passed through the Polar pack, and the latitudes attained by whalers have depended on the position of this pack in the different seasons. If it has drifted south late in the year, they have been able to go further north, and Captain Scoresby certainly, in 1806, reached 81° 30′, and found the navigation quite open for many leagues to the E.N.E. If, on the contrary, it has come down early, then they have been stopped in lower latitudes. So much for the whaling fables.

Attempts to reach the Pole were first renewed by the Russian Government, and Vassili Tschitschagoff, in two successive expeditions (1765 and 1766), perseveringly, but vainly attempted to find a way through the ice between Spitzbergen and Greenland. He only reached 80° 30′ N. At that period the President and Council of the Royal Society of England were ever foremost in urging the Government to undertake scientific expeditions. Would that their successors of the present day more closely followed their noble example. In 1773, a memorial was addressed by the Royal Society to the King, to obtain his sanction for an expedition to see how far navigation was practicable towards the North Pole.‡ Two vessels were forthwith fitted out and despatched, under the command of Captain Phipps, who had orders to proceed as near the North Pole as the ice would permit, but to return before the winter should set in. He made the attempt be-

* The Commissioners of Longitude, in 1821, reported that there was no well-authenticated account of any vessel having gone so far as 81° N.

† Captain Jansen (the learned author of that charming chapter on land and sea breezes in Maury's *Physical Geography of the Sea*) has undertaken to investigate this subject, and to examine such ancient journals of Dutch explorers as are still extant in Holland. He tells me that the learned Pontanus, in 1646, said in a speech:—"There are some persons who think the best route to the East is to go to 82° N. of Nova Zembla, or thereabout, because there the days and summers are longer, there is not so much ice, and it does not drift from the shore. Also because the climate is more mild than in 76° and lower down. Although I am convinced that this opinion is true, and that there will be no difficulty in navigating the sea when once in 82°, yet the difficulty is to come there and return." With this learned conviction for his starting-point, Captain Jansen will search for the data whence Pontanus derived his knowledge.

‡ By the Act 16 Geo. III. cap. 6, Parliament offered a reward of £5000 to the person who should first sail beyond 89° N. A new Act on the same subject was passed in 1814 (58 Geo. III. cap. 20). To the first ship that should sail to 83° N., £1000 was granted; to 85°, £2000; to 87°, £3000; to 88°, £4000; and to 89°, £5000. I am glad to see that, in the recent Acts of Parliament sweeping away a great number of Statutes (24 and 25 Victoria, cap. 101, and 25 and 26 Victoria, cap. 125), these rewards for Polar discovery have not been repealed.

tween Spitzbergen and Greenland, but was stopped, like Hudson, and so many others before him, by the Polar pack. He examined the pack edge very carefully, from longitude 2° to 20° E., but never got beyond 80° 48′ N. The expedition of Captain Buchan, in 1818, made the attempt in the same direction, but never got farther north than 80° 34′ N. This expedition, however, made a more extensive examination of the pack edge than the preceding one, having traced it from longitude 10° to 40°, both in the months of June and September, without finding a single lane or opening by which to enter it. Then followed a Russian expedition in 1824, when Admiral Luthe traced the edge of the ice, between Spitzbergen and Nova Zembla, from longitude 62° to 44° E., but he never got further north than 77°.*

These unsuccessful endeavours to find a passage for vessels through the Polar pack between Greenland and Nova Zembla, led Sir Edward Parry to conceive the bold idea of travelling over the ice in sledges and boats during the summer, and thus reaching the Pole.† His scheme was approved by the Admiralty of that day. He sailed in April, 1827, and leaving his vessel in Hecla Cove (lat. 79° 57′ N.), in Spitzbergen, he set off in two boats, with four sledges, and seventy-one days' provisions, on June 21st, going due north. He was stopped by the ice in latitude 81° 12′ 51″ N., and commenced the laborious work of dragging the boats over it on the 23rd.‡ But he had started too late in the season, the pack was much broken up and intersected with lanes of water, and it was drifting rapidly to the southward. After travelling over 192 miles of ice, Parry had only reached a latitude of 82° 45′ N. on July 27th, when he determined to cease his fruitless labours and return. From his extreme northern point a strong ice blink always overspread the northern horizon. Parry certainly met with an unusually open season, and the quantity of rain which fell and rapidly rotted the ice, is proved by the observations of Scoresby, during several years in the same region, to be quite exceptional. He returned to the ship after an absence of forty-eight days, having travelled over 569 miles. The failure of Parry was due to his having

* To complete the story of these vain attempts to penetrate through the Polar pack between Spitzbergen and Nova Zembla, it must be mentioned that a Russian expedition, commanded by Lieutenant Wrangel, started in 1863. That officer lost both his vessels in the ice off Nova Zembla, and escaped in his boats.

† Sir John Franklin had previously drawn up a plan for making this attempt, and volunteered to conduct it.

‡ Parry's weight per man was 260 lbs., a weight which subsequent experience has proved to be too great. 220 lbs. per man is the greatest weight that a party should start with in Arctic travelling. His allowance of food per man was not sufficiently liberal (biscuit 10 oz., pemmican 9 oz., cocoa powder 1 oz., rum 1 gill, tobacco 3 oz. per week).

started too late in the season. There can be no doubt that had he set out in February, when the ice is fixed, instead of the middle of summer, he would have been far more successful. As it is, no European has ever yet reached so high a northern latitude as Sir Edward Parry.

One more expedition requires notice, although it was in a totally different direction. After Hudson had ascertained the ice barrier between Greenland and Nova Zembla to be impenetrable, that worthy old pilot Baffin, in his little vessel, the "Discovery," of fifty-five tons, made an attempt further to the west, entered the bay which bears his name, pushed through the middle pack in twenty-two days, and discovered the entrance of Smith Sound in 1616. This, and not the Polar pack, is the true portal for future North Polar Exploration; but hitherto, only one expedition has attempted to explore it. Dr. Kane, in the little schooner "Advance," wintered there, from 1853 to 1855, and one of his travelling parties, pushing north along the Greenland coast, reached the latitude of 80° 40′ N., came to an open iceless sea, and saw land trending away to the northward, as far as the eye could reach. These Americans were undoubtedly the discoverers of the most northerly known land in the world. Dr. Hayes, a companion of Dr. Kane, has since wintered in Smith Sound, but no account of his proceedings has yet been published.

This completes the enumeration of expeditions which have attempted to penetrate into the North Polar region. The English Government has sent three expeditions to the edge of the ice between Greenland and Nova Zembla, those of Wood, Phipps, and Buchan, during as many centuries, and Parry's boat journey took place in 1827. No attempt has been made since the latter date.

Let us now consider what this vast unknown region is, and what results may be derived from its exploration. If we look at a North Polar chart, we shall see a blank space from 80° to the Pole, only very slightly nibbled at its circumference by Dr. Kane's party, who got forty miles beyond the 80th parallel in Smith Sound, and by Parry, who travelled over the ice into this unknown region for a distance of 165 miles. Here, then, is a vast circular tract of land, and sea, and ice, which is absolutely unknown, with a diameter of 1200 miles, and an area of 1,131,000 square miles.

Our complete ignorance of this large portion of our planet is in itself a strong reason for exploring it. Even if men of science were unable to specify any positive result beforehand, it might fairly be urged that the examination of this vast region must inevitably increase the store of human knowledge, and thus bear rich fruit. But, in truth, we have the highest

scientific authority for asserting that there are many questions of the greatest importance which call for investigation in the North Polar region.

Foremost among them is the subject of geographical discovery—the exploration of the northern side of that wonderful glacier-bearing continent of Greenland, and the completion of our knowledge of any other land that may exist within the unknown area. A very noble and unmistakeably English work is this. To use the words of one who has himself taken no small share in such work in former days, and who is now President of the Royal Society, "It is the greatest geographical achievement which can be attempted, and will be the crowning enterprise of those Arctic researches in which our country has hitherto had the pre-eminence." Phenomena never yet seen by mortal eye will be observed by the bold explorer who reaches the Pole. He will see the sun revolving with a uniform altitude from the day it comes north of the equator in March until it returns in September, its altitude being equal to its declination. He will ascertain new facts connected with terrestrial magnetism, and a series of valuable observations on variation and dip over this unknown area, will be of real practical utility.

One of the greatest scientific *desiderata* of the age is the accurate measurement of an arc of the meridian near the Pole, and this object alone would justify the despatch of a scientific expedition. By the measurement of these arcs in different latitudes, the length of a degree has been found to increase in regular proportion from the equator towards the Pole. The most northern measurement hitherto made is in latitude 66°·20 N. No measurement has been made sufficiently near the Pole, and it is of the utmost importance that this should be done, in order to ascertain the shape of our planet with scientific accuracy. It is not a subject to be touched upon lightly, for few people are fully aware of its difficulties, and of the extreme accuracy which is absolutely necessary in the observations. Still it is to be done, and the western coast of Smith Sound, between latitudes 78° and 82°, is the place to do it.*

The science of hydrography will be advanced, and some of its chief problems connected with equatorial and polar currents will be solved by a Polar expedition. The Polar region may be covered with ice, or considerable seas may be produced by the action of these currents during the summer. General Sabine believes it to be far from improbable that the equatorial stream may produce abnormal effects in the far north, and be the

* On Spitzbergen, which only extends from 76° to 80°, the measurement of an arc will not be so valuable; but it is, however, about to be undertaken by a Swedish scientific expedition.

cause of iceless seas during the summer, teeming with animal life. It is surely a matter of deep interest to discover the actual condition of this secluded ocean, which has never yet been cut by keel of mortal ship.

But although no vessel has ever entered those silent seas, there is every reason to believe that scattered tribes of men will be found on their shores, even up to the Pole itself, wherever the current keeps lanes and water-holes open during the winter. A study of the probable origin and migrations of the Greenland Esquimaux enables us to trace hardy tribes of wanderers from the northern shores of Siberia, where their ruined *yourts* and stone fox-traps were seen by Wrangell, along the whole length of the Parry Islands, which are strewn with exactly the same traces; and thus we follow their long wanderings, until their descendants are found at the head of Baffin's Bay. There the "Arctic Highlanders" at length found a land suited for a permanent abode of human beings, and thence parties may be supposed to have wandered south along the coast of Greenland, and north into the unknown Polar region, wherever there was land and open water. We know that they must have travelled round the northern end of Greenland, for Clavering found two families of Esquimaux on the east coast, to the northward of Hudson's Hold-with-Hope. Scoresby gives instances of stone darts, such as are used by no known people on this earth, having been found imbedded in the blubber of captured whales. These whales had escaped from the mysterious hunters of the Pole, only to yield up their stores of oil to the men of Hull and Aberdeen. The supposed inhabitants of the Polar region must depend on open lanes and water-holes, during the winter, for their existence, for without them there are no walrus, seals, or bears, and therefore no fuel for melting ice. Unacquainted with the use of metals, their implements must be exclusively of bone, stone, or driftwood. Now the discoveries of geologists have recently brought to light the existence of a race of people who lived soon after the remote glacial epoch of Europe, and who were also unacquainted with the use of metals. Their history is that of the earliest family of man of which we yet have any trace, while here, in the far north, there may be tribes living under exactly similar conditions, in a glacial country and in a stone age. A close and careful study of this race, and especially of any part of it which may be met with in hitherto unexplored regions, therefore assumes great importance, and forms a field of research which is well worthy of the attention of future Polar explorers.

The grounds for supposing that human beings have extended their wanderings towards the Pole also justify the

conclusion that the same region teems with animal life. It is peculiarly important that such a region should be examined in the interests of natural history. Not only may there be opportunities for studying the habits of animals as yet little known, and of discovering the long-concealed haunts of those right whales which have deserted Baffin's Bay, but it is also more than probable that new species may be found in the unknown north. Here may be the last hiding-place of that curious manatee (*Rhytina*), which was last seen by Steller in 1741, off Behring's Island, and which is conjectured by Professor Owen to have been separated from its natural habitat in the Indian Ocean, at some remote period, by the rising of the Asiatic continent. The seas which support whales and seals must be tenanted by myriads of fish, and of those minute organisms which are disclosed by the dredging-machine, while the presence of walrus tells us of submarine forests of sea-weed. The Arctic flora, too, is as yet very imperfectly known, as regards either the land or the sea; and Dr. Kane's expedition alone discovered twenty-seven new species of plants. The recent paper by Dr. Hooker, pointing out the geographical distribution of plants in the Arctic regions, suggests the light that may be thrown upon the interesting problems connected with it, and the incalculable value of researches into the botany of the unknown Polar region.*

The investigation of the geological character of the Polar region will throw a flood of light on the world's early history, and will be of incalculable value to science. It must be remembered that no professional geologist has ever been in the Arctic regions, and that the action of the vast glaciers of Greenland, with their mighty icebergs, has never been examined by a trained eye. Yet it is here alone that the condition of that remote period when all Europe was similarly situated, can be satisfactorily studied. The formations hitherto discovered in the Arctic regions, the tertiary lignite of Disco, the carboniferous sandstone of Melville Island, and the Silurian corals, trilobites, and cephalopods of other parts of the Parry group, all indicate a much warmer climate than now exists even in Europe. If similar formations are met with in close proximity to the Pole, we shall learn that there must once have existed conditions of life and heat there which are very different from those now prevailing. We shall receive additional proofs of that great internal heat which appears once to have warmed the earth's crust, and to have produced a rich vegetation in the Arctic zone. The geologists certainly have

* See *Outlines of the Distribution of Arctic Plants*, by Dr. Hooker. *Transactions of the Linnæan Society*, vol. xxiii., p. 251.

excellent reasons for the interest with which they regard the proposal to explore these regions.

There are many strange anomalies, too, connected with the meteorology of the North, as hitherto observed. The data already obtained are altogether insufficient to enable men of science to acquire a sound knowledge of the laws which regulate the climate of the Arctic regions. Captain Osborn has well said that nothing could be more deeply interesting than a careful series of meteorological observations within the Polar area.

These are some of the leading results that will be derived from a scientific expedition to explore the North Polar region, and most assuredly they would amply justify its despatch. There are probably many more additions to our knowledge to be secured in that vast area, of which we cannot form a conjecture now; but we know enough to convince all lovers of science that there is great and important work to be done, and that a naval expedition should do it.

It remains to consider the direction from which a Polar expedition might be undertaken with the greatest probability of success.

There are two accessible approaches to the Polar region, one by the Spitzbergen Sea, between Greenland and Nova Zembla, and the other through Smith Sound, at the head of Baffin's Bay. Looking round the circle formed by the 80th parallel, we see no other suitable opening. Behring's Strait appears to be one, it is true, but beyond it there is the most stupendous accumulation of ice that has ever been met with in the Arctic regions, and the northern openings between the Parry Islands are out of the question. The only routes, then, are those of Spitzbergen and Smith Sound.

The Spitzbergen route was originally proposed by General Sabine, the President of the Royal Society, who developed a plan for attempting it, and it is recommended by four other officers of Arctic experience, Sir Edward Belcher, Admiral Ommanney, Captain Richards, and Captain Inglefield, and also by Admiral Fitz-Roy. The idea appears to be that a base or depôt should be established in Spitzbergen, whence well-found screw steamers may do battle with the pack to the northward for two or three years, if need be, until success is achieved.

The argument in favour of this route is founded on the following considerations:—It is known that the Gulf-stream flows up between Spitzbergen and Nova Zembla, and that it issues south again as an Arctic current. This warm indraught is supposed to cause a navigable ocean, free from ice during the summer; and one theorist maintains that even in the depth of an Arctic winter a vessel may sail without obstruction

across the North Pole. But the facts upon which the theory of a Polar basin rests are that Wrangell met with thin and broken ice at a distance of about twenty miles from the Siberian coast, in February, denoting open water; and that Anjou saw the same water-holes off the islands of Kotelnoi and New Siberia.* When Barents wintered in Nova Zembla, in 1596, he also saw open water to the northward, in March, after a strong S.E. gale; but as soon as it began to blow from the N.W., the ice returned from that quarter. He naturally concluded, from this movement of the ice, that there must have been open water to the north, into which the ice was blown. The Russians call these water-holes *Polynias,* and they are occasionally seen in all parts of the Arctic regions, even in the depth of winter. They are caused by currents, and in Baffin's Bay also by movements of icebergs. It is obviously absurd for a man standing on the ice, and finding open water before him, to call it an "immeasurable ocean," when he can only see a distance of a few miles. An argument in favour of a warm Polar climate has also been derived from the supposed influence of unceasing sun-light during six months. Scoresby long ago calculated that, at the summer solstice, the influence of the sun is greater at the Pole than at the Equator by nearly one-fourth. But he points out that, on the same principle, the influence of the sun at 78° N. is only $\frac{1}{45}$th less than at the Pole, and also greater than at the Equator.† Now at 78° N., the mean temperature of the year is 17° Fahr., and ice is formed during nine months in the Spitzbergen seas, neither calm weather nor the proximity of land being essential to its formation. How, then, can the temperature further north be entirely different? It may readily be admitted that those parts of the Arctic zone where there is much land, such as Greenland and the vicinity of the Magnetic Pole, are colder than portions where there is a wide expanse of ocean; but to suppose that this difference is so great as to affect the existence or non-existence of ice is wholly inadmissible, even if the Polar pack did not yield a tangible proof that ice *is* formed round the Pole. Scoresby, by a careful calculation, finds the probable mean annual temperature of the Pole to be + 10° Fahr.

The only sound conclusion that can be arrived at from the above considerations is that the Polar region is frozen over during the winter, with occasional lanes and water-holes kept open by the currents; that this ice drifts south in the summer and autumn, and is gradually loosened and melted at its southern edge by the action of the Gulf-stream, the swell of

* The open water of Middendorf, off Cape Tainiyr, was seen in *August*, when it equally exists in all parts of the Arctic regions.

† Solar influence is proportional to the sines of the sun's altitude.

the ocean, and, in some seasons, by heavy falls of rain; and that young ice forms again, so as to impede and eventually to stop navigation, in September. An expedition taking the Spitzbergen route must therefore force its way through the Polar pack drifting south, before this young ice begins to form, otherwise the season for exploration is lost.

The vital question now arises—what is the width and condition of this pack? Parry, in 1827, ascertained that it was at least 192 miles broad, by walking over it, and at his extreme northern point in 82° 45′, a strong ice blink was seen on the northern horizon. This was in the end of July. We may, therefore, take its average width at that time of the year to be about 250 miles. It is hoped that an expedition may enter the pack between Spitzbergen and Nova Zembla towards the end of July, under favourable circumstances, notwithstanding the failure of all former attempts. This hope is based on the great advantage that steamers have over sailing vessels, and on the presumed action of the Gulf-stream in melting and loosening the pack. All then depends on the time that it will take for vessels to force their way through it.* Let us see upon what grounds we may calculate the probable length of this detention. The width of the Polar pack in the end of July is not less than 250 miles; that of the middle pack in Baffin's Bay is generally about 172. Now the average detention in Baffin's Bay, calculating from the time taken by the six expeditions, assisted by steam power (for we may now leave sailing vessels out of the question) has been twenty-two days. But by holding on to the land ice very little ground is ever lost in Baffin's Bay, and the existence of the land floe makes eventual success almost a certainty; while between Spitzbergen and Nova Zembla there is a drifting pack with no land ice to assist navigation, and progress is dependent on the chance of lanes opening in the right direction. With extraordinary luck, however, steamers might bore their way through this 250

* The analogy which has been attempted to be drawn between the pack in the Southern hemisphere, through which Sir James Ross forced his way (*Southern Seas*, ii. p. 183), and the Polar pack, between Spitzbergen and Nova Zembla, is entirely delusive. On December 18th, 1841, Sir James entered the pack, in latitude 60° 50′ S., and, after being beset in it for fifty-six days, at last emerged into open water on February 2nd. This pack was 800 miles wide. On the 24th he was obliged to relinquish all further exploration, on account of the formation of young ice, which threatened to freeze the ships up for the winter in a most dangerous position, but fortunately they were saved by a strong breeze (ii. p. 203). Thus he only had three weeks of navigable season left, after getting through the pack. This pack in the Southern hemisphere was met with in the temperate zone, after having drifted through hundreds of miles in a boundless ocean, and become loose and broken. The North Polar pack, on the contrary, is but a short distance from the place of its formation, and is in a confined sea surrounded on all sides by continents.

miles of pack in forty days, and reach open water beyond, towards the end of August. If an attempt is made to take the pack earlier in the year, it will of course be found to be much wider and closer, and the detention will be proportionally longer. Under fortunate circumstances, steamers may, perhaps, get through the pack in August, so as to have about a fortnight left for North Polar exploration in the supposed open water to the northward, before the young ice begins to form. It must be remembered that dense fogs prevail in summer wherever there is a large surface of open water, in the Arctic regions. If a navigable sea exists, however, some interesting discoveries may be made in its hydrography and fauna, and a series of useful magnetic observations may be taken. But the generally admitted absence of land* on that meridian precludes the idea of wintering in safety, and destroys all chance of obtaining many of the important scientific results which have been enumerated as attainable from North Polar exploration, when undertaken in the right direction. The objections to the Spitzbergen route are that the chances are against a successful passage through the Polar pack; that, even should this obstacle be overcome, there would be so little of the navigable season left that scarcely anything would be done; and that none of the objects of North Polar exploration would be attained in the event of failure, very few in the less probable event of success; while, if the vessels are prevented from returning before the winter sets in, they will be in extreme peril.†

We now come to the consideration of the Smith Sound route. This route is recommended by a great weight of authority—by Sir George Back, the Nestor of Arctic exploration; by Admiral Wrangell,‡ the discoverer of the northern shores of Siberia; by Admiral Collinson; by Sir Leopold M'Clintock, the highest living Arctic authority; by Sherard Osborn, whose admirable paper first brought North Polar

* Some of the advocates of the Spitzbergen route speculate on the existence of land; but the whole argument in favour of that route is based on its supposed absence. This supposition is founded on the absence of icebergs and of any mud or débris on the ice, of which the Polar pack is composed. The argument is perfectly sound so far as it goes.

† Open lanes and water-holes, no doubt, exist throughout the winter in the Polar region, caused by currents, and the ice is thus kept in occasional motion by gales of wind. It is this condition of the ice which would cause the extreme danger of wintering in the Polar pack north of 80°, at a distance from any land. The ships would be kept in motion, and perhaps dashed about amongst heaving blocks of ice in a gale of wind, at a time of year when the incessant night and the intense cold render navigation out of the question. The men would find it impossible to work aloft, and the running rigging would be frozen too hard to reeve through the blocks.

‡ See *Royal Geographical Society's Journal*, vol. xviii., p. 19 (1848).

exploration into notice; by Vesey Hamilton, whose Arctic experience is only second to that of M'Clintock; and by Captain Maury, the great American hydrographer.

Smith Sound is ascertained to be a broad strait leading into the unknown Polar region, and its shores are the most northern known land in the world. They are, therefore, the best point of departure whence sledge parties may push onwards over the Polar region, and the best wintering station for vessels forming a scientific expedition. It is proposed that two well-fortified gun-boats, of 60-horse power, should proceed up Baffin's Bay to Smith Sound; that one should winter near Cape Isabella, at its entrance, and that the other should go further north, so as to winter at a distance of about 300 miles from her consort. There is no doubt about vessels being able to reach the entrance of Smith Sound, at the head of Baffin's Bay, every summer. The ice drifting from the seas, whose portals are Smith, Jones, and Lancaster Sounds, forms what is called the *middle pack* during the summer, stretching across the centre of Baffin's Bay; while the head of the bay, upon which the above sounds open, is always free of ice in the summer, and is called the "*North Water*." The *middle pack* is about 170 miles wide, and the reason why it may always be passed, while the Polar pack cannot, is that on the eastern side of Baffin's Bay there is an indentation called Melville Bay, filled with ice firmly attached to the land, and known as the *land floe*. Vessels make fast to this *land floe*, while the middle pack drifts past, and thus creep up through a lane of water which is occasionally left between the fixed and drifting ice, sooner or later reaching the "*North Water*." Out of thirty-eight exploring vessels that have gone up Baffin's Bay since its discovery in 1616 not one has been lost, and not one has failed to reach the "*North Water*" when the necessary conditions of success have been observed—namely, arrival at the edge of the ice early in the season, and sticking to the land floe. Two only* out of thirty-eight have failed, and neither adhered to these conditions. The whalers do not persevere in the attempt, unless they can pass through early in the season, yet, in twenty-seven out of thirty-two years, from 1817 to 1849, they succeeded in reaching the "*North Water*." In 1849 a whaler reached the "*North Water*" by the 12th of June, and in the years 1825, 28, 32, 33, and 34

* One of these was the "North Star," in 1849. She took the pack, and was drifted across Melville Bay, not getting clear of the ice until the navigable season was over. She started very late in the summer. In the very same year a whaler (the "St. Andrew") reached the "*North Water*" on June 12th, a clear proof that if the "North Star" had started early, she would have got through successfully.

the whole fleet of whalers got through early in July. It must be remembered that the whalers do not persevere after the middle of July, while there will be time for a discovery ship to reach Smith Sound, even if she does not get through, before the end of August. It may be counted upon with certainty that two screw-steamers of 60-horse power will get through the *middle pack* (on an average) in about twenty-two days, if they start early in the season, and that they will reach the *"North Water."* The *"North Water"* means Smith Sound, for it always extends to the entrance of that great opening whence Captain Inglefield in 1852 saw open water to the northern horizon, stretching through seven points of the compass.

The two gun-boats would winter about 300 miles apart, one near Cape Isabella and the other near Cape Parry, both on the weather or western side of Smith Sound. The march to explore the Polar region would commence in February, along the coast which stretches to the northward. The ice is always firm, and fit for travelling near the shore, from February to May; and this circumstance led Wrangell to advocate the Smith Sound route, for he well knew that his *Polynias*, or open lanes of water, were not encountered until he advanced a considerable distance from the coast. The distance from Cape Parry to the Pole and back is under 1000 miles; so that a party going to the North Pole, and travelling at the rate of about ten miles a day, would be back by the middle of May. Mr. Arrowsmith places Cape Parry in 81° 56′ N., or 484 miles from the Pole; and Dr. Kane's steward saw land stretching away to the north as far as the eye could reach. Give us only 184 miles of land north of Cape Parry, and a sledge journey to the Pole is a matter of calculation* if performed during the winter and early spring. The discovery of the North Pole by this route does not depend upon a drifting, treacherous pack, upon the opening or closing of leads through the ice in the right direction, or upon a theoretical Polar basin, as is the case in the Spitzbergen seas. By the Smith Sound route the discovery is a certainty, so far as human calculation can make it so. Sir Leopold M'Clintock has brought the art of sledge travelling to such perfection, that this may be affirmed with perfect truth. Much has been said, by objectors to this route, about the impossibility of dragging heavy boats over the ice. All who are acquainted with M'Clintock's

* A sledge party, commanded by M'Clintock, has walked 1220 miles in 105 days; on another occasion, 1330 miles. Mecham did 1203 miles, Richards 1093, Osborn the same. Allen Young 1150, and Hamilton 1150. Sir Leopold M'Clintock says that a single sledge may carry sixty days' provisions, and go over 600 miles of ground, without assistance from depôts.

system of travelling, know well that such an idea would never enter his head. He would probably supply each sledge with a very light India-rubber boat, and narrow lanes of water would never stop him. If he arrived on the shores of a great navigable ocean in an Arctic winter, then, of course, his progress would be arrested. But, at the same time, a marvellous discovery will have been made, and his researches will be turned in other directions, leading to results of equal value and interest. The northern side of the Greenland continent will be carefully examined, as well as all the land to the westward. We may rely upon it that immense results will be insured by the exertions of scientific explorers wintering for two seasons in Smith Sound, that every branch of science will be enriched by their labours, and that, even if success is denied them in their endeavours to reach the Pole, their achievements in other directions will repay the expenses of the expedition a thousand-fold.

The advantages of the two routes will not bear comparison. The Spitzbergen route offers, in the event of success, a chance of reaching the Pole, and the opportunity of exploring the supposed Polar basin; but everything must be done very hastily, and therefore inefficiently, during the brief navigable season. In the probable event of failure the vessels will have accomplished nothing. They will have been a month or two struggling in the pack, and will at last be drifted out again, either whole or in pieces.

The Smith Sound route, on the other hand, offers the discovery of the North Pole, of the northern side of Greenland, of the land to the westward, and all the numerous results in every branch of science, which are expected from a North Polar expedition. Moreover, the explorations will be made by sledges, and therefore carefully and thoroughly. In the event of failure in securing the main object, all the other results will be attained; so that, under any circumstances, good and useful work will be done.

By the Spitzbergen route there is the bare chance of doing little, by the Smith Sound route there is the certainty of doing much.

Three objections have been raised to another Arctic expedition: first, that it will be no use; secondly, that it will be dangerous; and thirdly, that it will be expensive. After what has been said of the great and beneficial results, both direct and collateral, which may be expected from North Polar exploration, it is unnecessary to dwell upon the first objection. There are many people who, with the *Times*, are altogether incapable of comprehending that there can be anything worth doing, which does not promise good interest on

outlay, in hard cash; and to speak to them of advantages other than an actual money profit on goods delivered, would be a mere waste of breath. Yet even they might be reminded of the actual commercial profit that has been derived from Arctic Expeditions. The voyages of Willoughby and Chancellor opened the rich trade with Archangel. The discoveries of Hudson led to the lucrative Spitzbergen whale fishery, those of Davis and Ross to the equally remunerative fisheries in Davis Strait and Baffin's Bay. The discoveries of the Danes in Greenland have yielded supplies in ivory, cryolite, and graphite. The Russian and Arctic expeditions have opened a rich trade in fossil ivory. Lastly, the voyages up Barrow's Straits have resulted in an extensive series of magnetic observations of practical utility to navigation.

But the public have a right to inquire closely whether any future expedition would incur even the remote possibility of such a fate as befel the "Erebus" and "Terror," and to this objection a satisfactory reply may properly be demanded. There is no analogy whatever between the ill-fated expedition led by Franklin, and that which, it is hoped, will be despatched to Smith Sound for North Polar exploration. No one feels this more strongly than the noble-minded widow of that great explorer. In the latter case, a vessel will be stationed at a point whence annual communication with England is easy and certain, and whence a retreat to the Danish settlements in Greenland is perfectly devoid of all risk; while Franklin was sent into an unknown region, without a thought of providing for his safe retreat in the event of disaster. Had one of Franklin's ships remained off Cape Warrender, at the entrance of Lancaster Sound, and the other not gone beyond Cape Riley, they would have been quite as safe as if they had never left Greenhithe. The Smith Sound exploring vessels, stationed at Cape Isabella and Cape Parry, will be in exactly similar positions, for Smith Sound, like Lancaster Sound, opens on the "North Water" of Baffin's Bay. It is not, however, to be supposed that there will be no individual danger to those who gallantly come forward to serve in a Polar expedition of discovery. On the contrary, it will be a service requiring great powers of endurance, courage, and self-reliance of a high order, and indomitable resolution. But it is the desire to overcome difficulties and dangers, and to emulate the deeds of former naval worthies, which induces men to volunteer for such service. Suffice it to say that the climate is the healthiest in the world, and that a retreat from Smith Sound to the Danish settlement of Upernavik in summer, if it should become necessary, is easy, and free from danger.

The objection on the score of expense will doubtless be raised with more sincerity, at least, than is this unworthy attempt to discourage naval voyages of discovery on the ground of danger. But if the despatch of a scientific expedition, the results of which will be shown to be important by the leaders of science, is to be refused owing to the trifling expenditure it will occasion, let us be told so at once; and let not those who would advocate any iniquitous war with China or Japan, in pursuit of the main chance, protest against the imaginary risk of a scientific expedition. M'Clintock's voyage, and he was absent two years and a half, cost £8400. Parry's attempt to reach the Pole cost £9900. The actual expense of a Polar expedition up Smith Sound, consisting of two of those numerous 60-horse power gunboats which are now lying idle, or being sold to be broken up, would not exceed £30,000. Now if the solution of the greatest geographical problem that remains to be solved, and the attainment of those scientific results which have already been enumerated, are not considered worth the expenditure of so trifling a sum—an expenditure which would be richly and abundantly repaid—the character of the English people must be strangely altered. Certain it is that our forefathers would have held that such a sum appropriated for such an end was money well spent; and there is good reason for the belief that if the subject receives full and fair consideration, the public opinion of the country will now approve the despatch of a North Polar expedition. During the last ten years the sum of £150,000,000 has been spent upon the navy, out of which only a 230th part has gone to the scientific department of the profession. Surely it is not much to ask that this infinitesimal proportion should be imperceptibly augmented, in order that an important and valuable service may be performed!

An expedition for North Polar discovery, by way of Smith Sound, will yield most useful scientific results, will add largely to the sum of human knowledge, while it will run no risk of a catastrophe such as that which befel the crews of the "Erebus" and "Terror." For these reasons it deserves such cordial support from the public opinion of the country as will induce the Government to undertake it. When it is remembered how beneficial are the indirect advantages invariably derived from voyages of discovery, and how important it is that naval officers should have some nobler career opened to them, in times of peace, than the ceaseless round of holystoning decks and cleaning brass work, an interest will be felt in these voyages, even by men who do not personally appreciate their scientific results. The same enterprise, courage, endurance, and presence of mind are required to conduct an Arctic

expedition as to face an enemy in the field; but in the former case those qualities are exercised in advancing civilization, extending knowledge, and exciting friendly sympathy and interest throughout the world; in the latter, they are wasted in the deplorable operations of war.

NOTES ON FUNGI.—No. III.

BY THE REV. M. J. BERKELEY, M.A., F.L.S.

WHITE-SPORED AGARICS—RINGLESS OR EXCENTRIC.

(*With a Tinted Plate.*)

It is not strictly correct to say that there are no ring-bearing species in the remaining subdivisions of the white-spored Agarics, but as the few which have rings belong to the division which is characterized by the pileus being always more or less excentric, there is no great difficulty about the exception.

The subdivisions or subgenera are *Tricholoma, Clitocybe, Collybia, Omphalia, Mycena,* and *Pleurotus,* in all of which the part which bears the fructifying surface is confluent with the stem. The first which requires notice is *Tricholoma,* whose name is derived from *θρὶξ,* a hair, and *λῶμα,* a fringe or border; but the name is deceptive, for if anything like a veil is ever present it is quite rudimentary; at any rate, its threads are never interwoven into anything like a membrane, so that no permanent veil must be looked for. The grand point of distinction consists in the gills always being sinuated or emarginate behind (Fig. 1),* while the stem has no distinct bark-like coat of a different consistence from the rest. As observed before, some *Armillariæ* are distinguished only by their ring, while *Amanita* and *Lepiota* have the hymenophorum quite distinct from the stem. All the species grow on the ground, and most of the large ones are esculent; indeed, no species which is confessedly poisonous is contained in this subgenus. Where, however, experiments are made in doubtful species, great stress should be laid on the absence of any disagreeable taste or smell.

The primary sections of *Tricholoma* rest on the presence or absence of any viscid coat. It must be remembered, however, that a species may be perfectly dry in hot weather, which is dripping with a viscid moisture when wet. Some of the viscid

* A vertical section of *A. colossus*, a magnificent Swedish species, which is chosen for illustration as it is so very characteristic.

species have pure coloured gills, which do not change their tint as they grow old, while others are more or less defaced with reddish-brown spots. One or two in either group are abundant in our woods, but they do not recommend themselves to notice as likely to prove good articles of food. Amongst the species which are not viscid, the cuticle of the pileus (2) may break up into more or less delicate threads or downy fascicles; it may be rigid (3), and present granules or smooth scales; it may be perfectly dry (4), and though minutely silky at first, be quite smooth when full grown, and neither floccose nor scaly; it may be moist, though not viscid in damp weather, as is the case in the remaining sections, and spotted (5), where drops of water have rested, or minutely cracked; the substance may be spongy and absorbent (6), and greedy of water, though when saturated it does not look semi-transparent, or when dry become opaque, or, in other words, it is not hygrophanous; while, finally (7), it may be hygrophanous, a very important distinction.

The section which contains the most valuable esculents is the fifth, where the species are mostly of early growth. *Agaricus gambosus*, which is the true St. George's agaric, though a species nearly allied to the common mushroom has been mistaken for it, is often extremely abundant in exposed grassy pastures, after the first copious spring rains in April or May, and is one of the best esculents in the subdivision. It is much eaten on the Continent, though generally neglected in this country, and one or two allied species are strung upon threads and dried for winter use. The pileus, when fully grown, if the weather is dry, has often a shining silky look, and closely resembles a cracknel. Of this we give a reduced figure, as it is highly characteristic of the subgenus (Fig. 2). *Agaricus personatus*, commonly known under the name of Blewits, belonging to the sixth section, is sometimes sold in Covent Garden Market, and is occasionally eaten. It occurs rather late in the year, remaining till the frost destroys, and is often sodden with moisture, in which condition it is not worth notice. It may be readily known from its very obtuse smooth pileus, and the stem being more or less rough with down or fibres, and prettily tinged with violet. Woodland forms are sometimes of a brighter tint. It often forms large rings. In the fourth section there are some interesting but disagreeable species. *A. sulfureus*, which is remarkable for its sulphur-yellow colour, has a decided scent of gas-tar, while *A. inamœnus* is scarcely less unpleasant, though it does not seem to attain the same intensity of odour with us as it does in Sweden.

Agaricus carneus, a small species belonging to the fourth section, which not unfrequently occurs in exposed pastures, remarkable for its neat form and pretty pileus, of a tint between

FUNGI.

1.—Agaricus colossus.
2.—A. Gambosus.
3.—A. carneus.
4.—A. geotropus.
5.—A. fusipes.
6.—Agaricus racemosus.
7.—A. affricatus.
8.—A. sanguinolentus.
9.—A. dryinus.
10.—A. applicatus.

red and flesh colour, may be cited because, in the character of the stem, it approaches *Collybia*, though the pileus and gills are quite those of the truest *Tricholoma*, as will be seen by the subjoined figure (Fig. 3).

Clitocybe, a name derived from *κλίτος*, a sloping, and *κύβη*, a head, is the designation of the next subgenus. It is closely allied to *Tricholoma*, but is distinguished by the gills not being sinuated behind, but regularly attenuated and running down the stem. Few of the species are eaten; but *Agaricus nebularis* and *geotropus*, or, at least, that form of the latter which is figured by Batsch, under the name of *A. subinvolutus*, of which we give a reduced figure, are excellent (Fig. 4). We have partaken of the common form, under the auspices of Dr. Badham, but did not consider it good, though, like several other species of the subgenus, it is wholesome.

The species are often rather difficult of determination, as the differences are less striking than in most other subgenera. The main divisions consist of—(1), those with an obtuse pileus, like *A. nebularis*, which at length becomes more or less plane; (2), species with an irregular, often sub-oblique pileus, with unequally decurrent gills; (3), those which, though at first umbonate, become at length entirely infundibuliform, with long and equally decurrent gills. In all these the pileus is not hygrophanous as in the three following—(4), species with a thin, almost membranous, cup-shaped pileus; (5), those, on the contrary, which are subcarnose, convex at first, then plane or depressed, with the gills adnate, or only very shortly decurrent; while (6) the last has again a thin pileus, which is often scaly or perfuraceous.

In the first section, besides *A. nebularis* already mentioned, which is conspicuous amongst leaves in woods for its pale cinereous, somewhat pruinose pileus and elastic fibrillose stem, and which is very highly esteemed as an esculent, one of the most remarkable is the greenish *A. odorus*, not uncommon in woods, which diffuses a strong scent of aniseed. In the second, *A. fumosus*, which sometimes forms dense tufts, is one of our best known species. In the third, we have *A. giganteus* and *maximus*, which acquire a diameter of a foot or more, and the latter of which forms sometimes rings in woods many feet across, besides which there are many allied British species, some of which are extremely common. In the fourth section, one of the most common towards the end of autumn is *A. cyathiformis*, its brown, cup-shaped, hygrophanous pilei being conspicuous both in woods and pastures; in the fifth, *A. fragrans* will obtrude itself on notice by its fragrance, resembling that of *A. odorus*, though its form and colour are different; while in the sixth, we have the commonest of all

woodland species, *A. laccatus*, where it is sometimes of a rufous flesh colour, but sometimes of the most lovely amethyst, the cuticle being always more or less mealy. Other varieties of this common species occur; one, which combines both colours, which I have gathered in fir-woods in Scotland, and another of a bright orange yellow.

In *Collybia* (from κόλλυβος, a piece of money) we enter upon another series, in which the hymenophorum is of a different substance from the more or less cartilaginous stem. Fries even seems inclined to separate this and the two following subgenera from other agarics, under the name of *Chondropus*. Most of the species are small, but there are one or two which are very conspicuous. We have here four sections: 1st, those in which the stem is rather stout and sulcate, or fibrilloso-striate; 2ndly, species in which it is velvety, floccose, or pruinose; 3rdly, those which have a slender nearly equal fistulose stem, which is smooth, except at the base, and even; and 4thly, species with dusky gills.

One of the most common agarics in our woods is *A. radicatus*, which is remarkable not only for its deeply rooting stem, but also for its wrinkled, glutinous, but scarcely moist pileus. *A. platyphyllus* is one of our finest species, and easily known from its long, thick, white string-like roots; while *A. fusipes*, which grows in clusters at the foot of oaks, has the pileus frequently deeply cracked, and springing from a stem swollen in the middle, and it should seem, from the observations of Léveillé, throws up new individuals from the base of the old stem, as indeed is the case in the specimen figured (Fig. 5). This, though unfit for stewing from its tough consistence, is one of the best species for pickling. Under the second section we may notice *A. velutipes*, a species conspicuous for its bright colours and beautifully velvety stem, enduring a good deal of cold, and occurring upon almost every kind of timber. It is one of the commonest species, and must be known to almost every one. A host of smaller species occur, one or two of which are parasitic on some of the larger gill-bearing fungi, and are remarkable for forming dense cellular masses which live through the winter, and produce the perfect fruit in the following year.* One of these, *A. racemosus* (Fig. 6), is the most remarkable perhaps of all the Agaricus, as it not only produces a pileus, but a quantity of heads on the stem, which have quite a different structure, and have different spores. In the third section we meet again with a small though esculent species, *A. esculentus*, which, under the name of nagelschwämme, frequently appears in the markets of Germany. Of the fourth

* An account of some of these has already been given in a former volume of the INTELLECTUAL OBSERVER.

little need be said, as we have very few representatives, and those of little interest.

Omphalia, as the name (from ὀμφαλὸς, a navel) implies, is distinguished by its pileus being depressed, or umbilicate, from the earliest stage of growth, while in *Clitocybe* this form is only assumed at a later period. Most of the species are small, and the subgenus does not seem to contain a single species which is confessedly esculent. There are two principal groups, in the first of which the margin is incurved and involute, while the pileus is from the first dilated; in the second the pileus is at first campanulate, and the margin straight and pressed to the stem.

It is not easy to point out any very conspicuous examples, but I figure as an illustration *A. affricatus* (Fig. 7), found in Aberdeenshire in 1862, which, like some of the other species, grows on *Sphagnum* in wet places. *A. muralis*, as the name implies, often grows on the capping of stone walls, and is of a reddish brown colour; while *A. umbelliferus*, with its broad, triangular, very distant gills, assumes all sorts of colours, as grey, green, yellow, etc., and occurs in as great a variety of climates. The second division consists of small but often very pretty species, one of which, *A. campanella*, may be often found on fir cones, where it is remarkable for its abundant tawny mycelium.

Mycena, named from μύκης, a fungus, comprises a multitude of extremely pretty species, which are generally small, and sometimes almost minute, and is with difficulty distinguished from the second section of *Omphalia*, having like that the margin of the pileus straight and never involute. The pileus, moreover, is not as in that umbilicate; nor are the gills truly decurrent, though in a few instances there is a strongly developed decurrent tooth. The genus does not contain a single economical species; indeed, the small size renders them unimportant in this point of view, and some are probably poisonous, as indicated by the strong alkaline odour.

The sections are numerous. 1. We have the edge of the gills of a different colour from the hymenial surface—a circumstance which renders many of them extremely pretty. Several examples occur in our woods, of which, perhaps, the most common is *Agaricus elegans*, the gills of which have a yellow edge. 2. The next section includes species of pure tints, unmixed with grey or brown, in which the stem is dry, and the base not dilated. *A. purus*, which is remarkable for its strong scent, resembling that of radishes, may be found in every wood, where it attracts notice by its beautiful rosy or purplish tint. The milk-white *A. lacteus* often occurs in profusion on fir-leaves, looking at a distance like large snow flakes. 3. A

third section contains species with rigid juiceless stems, with gills which are at first white, and then change colour. They are inodorous, and often very difficult of determination. *A. galericulatus* is extremely common on trunks of trees, and assumes a variety of forms. A nearly allied species, *A. polygrammus*, which is far from uncommon, is known by the deep striæ of the shining stem, which run down for a great length. 4. The species of the fourth section differ from the last in being mostly strong scented, and having a brittle or soft, and not rigid, stem. *A. alcalinus* may be found everywhere, and the scent is very disagreeable. 5. In this section the stem is thread-shaped, and rather tough. The gills change colour, and are paler at the edge; like the species of No. 3, they are inodorous. One of the prettiest, which is not uncommon, *A. acicula,* is scarcely larger than a common pin, and has a scarlet pileus and bright yellow stem. 6. This section is distinguished by the gills and stem distilling a milky or coloured juice. *A. sanguinolentus* (Fig. 8), in which the juice is of a madder red, is a common example. In *A. galopus* the juice is white and milky, and there are some other native examples. 7. The species of this section have a viscid stem. *A. epipterygius* is common on dead fern and elsewhere, and is very pretty. *A. roridus,* which occasionally occurs on twigs of bramble, in wet weather, absolutely drips with mucus. *A. vulgaris* occurs sometimes in myriads in fir woods, but it is not common everywhere. 8. This is a pretty section, remarkable for the species having the base more or less dilated. Few things are prettier than the minute *A. pterigenus,* with its rosy pileus and broad distant gills. It adheres to dead fronds of fern, by long radiating strigose threads. 9. Finally, we have minute species which grow on leaves and twigs, in which the stem springs at once from the matrix without any dilated base, as if it were grafted. *A. corticola* is abundant everywhere on the bark of trees, drying up in hot weather, and reviving with the first shower. It assumes various tints.

There remains only in this division of the genus Agaricus the subgenus *Pleuropus,* which, like *Armillaria,* contains species which are not closely allied to each other. Some differ only from *Tricholomata* in growing on wood and having an excentric stem. Some have a distinct veil, as *A. dryinus* (Fig. 9), which is sometimes a very pretty species. These have more or less decurrent gills. Others have no veil, but a distinct excentric or somewhat lateral stem. Many of these are large and important species. *A. ulmarius* attains a great size on the trunks of elms, and with some others has the gills sinuated behind, exactly as in *Tricholoma.* *A. subpalmatus* is remarkable for its dry but gelatinous coat. *A. lignatilis* occurs abundantly

at Burnham Beeches, and, if Fries is correct, the esculent white-seeded species, *A. markii*, which occurs in cellars at Vienna, on wine casks and mouldering beams, is the same thing. Other species have the gills very decurrent. Of these, *A. ostreatus* is common on various trees, especially the laburnum, and is considered esculent, but it must be a very coarse, unpleasant food, and care must be taken not to confound it with *A. Euosmos*, a poisonous kind, known by its scent, like that of tarragon, and its pale pink spores. A fatal accident was nearly occurring to a schoolmaster in Suffolk from confounding the two species. Curious specimens of *A. ostreatus* sometimes occur in cellars, bearing multitudes of minute, imperfectly formed pilei, and packed into a large mass which looks like a cauliflower.

In a third section the stem entirely vanishes, or exists only in a very early stage of growth, and the surface of the pileus rests on the matrix instead of the gills. In some of these the cuticle consists of a thick gelatinous coat, or there is a similar stratum in the substance. The species are many of them interesting from their form, colour, and sculpture, and as exhibiting the most degraded type which can be assumed by the genus. In a few the substance of the pileus is a mere membrane, and almost the whole plant consists of gills. Fig. 10 represents *A. applicatus*, which is a good example of the section.

Most of the species of this subgenus grow on wood, a few only on the ground. *A. tremulus* sometimes occurs on decayed fungi. The species do not dry up in decay, but become putrescent, which distinguishes them from the genus *Panus*. Most of the large species appear to be esculent. *A. corticatus*, which has occurred at Belvoir, is one of the most beautiful of British Fungi. The figures are all more or less reduced.

DESCRIPTION OF PLATE.

Fungi (white-spored mushrooms, ringless or excentric).

1.—Agaricus colossus.
2.—A. gambosus.
3.—A. carneus.
4.—A. geotropus.
5.—A. fusipes.
6.—Agaricus racemosus.
7.—A. affricatus.
8.—A. sanguinolentus.
9.—A. dryinus.
10.—A. applicatus.

OBJECTS VIEWED THROUGH THE CORNEA OF THE INSECT EYE.

BY THOMAS PRINCE.

Microscopists are aware of the usual method of proving that the compound cornea of the eyes of insects are composed of numerous lenses, merely by placing beneath the stage, and behind the mounted cornea, any strongly defined object, a candle, a knife point, etc. A really interesting and beautiful arrangement, adapted for a *soirée* or public exhibition, may be made as follows :—

a, Fig. 1, represents the lamp flame; *b*, a three-inch bull's-eye condenser, so placed in relation to the lamp as to

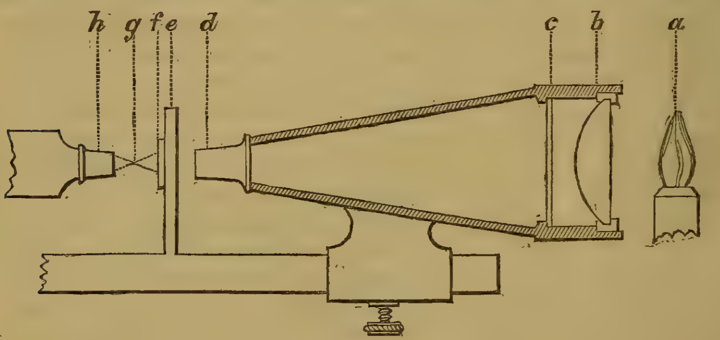


Fig. 1.

produce parallel rays; *c*, a photograph on glass, known as a "transparent positive," this in my case represents a portrait of Shakspeare—it is three inches diameter, and placed near the bull's-eye; *d*, an achromatic condenser; *e*, stage of microscope, distant about ten inches from *c*, the photograph; *f*, an ordinary slide of the cornea of an insect's eye, known among microscopists as one "mounted to show the image"; *g*, shows the point where the image is formed, a little in front of the cornea; as the picture will not be seen when the facets of the eye are in focus; *h* represents a quarter-inch objective, supposed to be in its ordinary position in the body of the microscope.

In adjusting the focus to find the image, it is desirable to work the rackworks of the body and the condenser at the same time, as the slightest movement of one affects the focus of the other. The apparatus described above, if carefully centred with the body of the instrument, will produce a novel and pleasing result, showing as many distinct portraits as there

are facets within the range of the objective. The same result may be produced by placing the microscope in an horizontal position, with the picture, etc., in their relative places, supporting the photograph on a temporary stand; but a slight difficulty occurs, in accurately centering the light, the bull's-eye, and the picture, so as to be in exact coincidence with the axis of the achromatic condenser. This may be got over by enclosing the whole by a tube temporarily fixed to the lower bar of the instrument, as shown in the diagram. By this plan, the whole may be at any time adjusted in a few minutes with the greatest ease and certainty. Fig. 2 represents a portion of the view as obtained by the above means. The uniformity of the portraits show these minute lenses to be of most astonishing accuracy and equality of form. And our admiration is excited at their delicacy of construction when we recollect that the picture is reduced by this minute marvel of design from one inch to the $\frac{1}{700}$ of an inch in diameter, or, in other words, it is reduced in size 2100 times, occupying a surface so small as to require 490,000 to cover one square inch.

FIG. 2.

VISIT TO MOUNT ETNA—AGE OF A CHESTNUT TREE.

BY CAPT. R. SMITH, LATE H.M. 44TH REGIMENT.

In June, 1811, being employed on the Quartermaster-General's staff in Sicily, and engaged in making surveys of various localities, I visited Mount Etna, and of course did not neglect to examine that vegetable wonder, the Castagno di cento Cavalli, which seemed to me, as it had done to other travellers, not what was expected—a single tree, but apparently a cluster of five distinct trees, since reduced, I understand, to three. A late traveller has remarked, and I think with good reason, that a large tree may have existed on the spot, and that on its destruction in some of the many convulsions that have so often shook Etna to its very centre, the present cluster of trees sprang from its root.

But it is not of the Castagno di cento Cavalli that I am about to speak, it is of a more wonderful production of nature

in my opinion, which stands within a few hundred yards of that celebrated tree; it is the Castagno la Nave, a noble patriarch of the forest. This tree rises in an unbroken stem for about forty feet, then divides and throws out lateral branches to an enormous extent. It appeared to me, as I viewed it, to be comparatively a young tree, from the vigour of its growth and absence of decayed branches. I was accompanied by a friend, and after contemplating with admiration this splendid specimen of the vegetable kingdom, we proceeded to measure it with a surveying tape, and at four feet from the ground it measured fifty-four feet in circumference. I need scarcely add that I entered this measurement in my note-book. I took a drawing of the Castagno di cento Cavalli, which shows almost beyond a doubt, that this never was a single trunk, but a group; but from some cause, which I do not now remember, I neglected to add its noble companion to my other sketches; but I afterwards saw at Messina a very beautiful drawing of this tree, in the portfolio of my friend Lieut. Wright, of the Royal Staff Corps.

On reading *Murray's Handbook of Sicily*, which has been recently published, it is there stated that this very tree was carefully measured within the last year, and was found to be fifty-seven feet in circumference at three feet from the ground, nearly at the same height that I measured it, thus showing an increase in girth of three feet in fifty-three years. If, therefore, we take for granted that the growth was the same every fifty-three years, the calculation makes the tree now 1007 years old; the following formula will show it more clearly:—

$$\begin{array}{lll} \text{If 3 ft.} & \text{53 years} & \;\;57 \text{ ft.} \\ & & \;\;\underline{53} \\ & & \;171 \\ & & \underline{285} \\ & & \underline{3)3021} \\ & & \underline{1007} \text{ years.} \end{array}$$

But if we presume that the tree increased in bulk somewhat more than three feet in fifty-three years in the early period of its growth, which by the by does not appear to be generally the case, for I have examined the annual rings in the trunks of many newly cut down trees, and found them on an average of equal thickness throughout, except towards the south or sunny-side, where they are generally thicker, on the same principle that plants grown in a window will always increase more

towards the light. But even allowing this, it would still make the tree nearly 1000 years old, no contemptible age; and although it is now showing symptoms of decay, for it is said to be partly hollow, yet it is not impossible but what it may, if the lavas of Etna spare it as they have hitherto done, live some five or six centuries more.

It is stated in the *Handbook* that there is another chestnut tree, a little further up the mountain, seventy-six feet in circumference, but this I did not see, nor did the guide mention it, and in those days handbooks were not as plentiful as they are now. I therefore missed it, and indeed might probably have missed also seeing the Castagno la Nave, if my attention had not been directed to it before I left Messina, for the guides are so taken up with the Castagno di cento Cavalli that they can think of nothing else.

I may mention that I also measured an oak tree a little lower down the mountain, and found it forty-six feet in girth; but it was much decayed in the branches, and probably considerably older than the Castagno la Nave.

How these trees have escaped for so long a period the devastating streams of lava and irruptions of fiery cinders that have within that period destroyed innumerable towns and villages, exterminated hundred of miles of vineyards and olive groves, and buried thousands of human beings, is indeed a wonder and almost a miracle.

ART SUBJECTS AND THEIR TREATMENT.

The Exhibition of Pictures at the Royal Academy for the year 1865 possesses, on the whole, a very considerable amount of merit, but we cannot say that it leaves the mind of an "intellectual observer" quite satisfied with the indications it affords of the state of education, thought, and feeling in the artist-world; although the choice of subjects is as varied as might be expected in a collection of more than a thousand works, produced at a time when no special books or circumstances exercised a dominant influence over picture-makers or picture-buyers.

The absence of works adapted to public buildings is the natural result of there being no demand for them. Our cities and towns are not yet civilized enough to devote any portion of their wealth to the gradual accumulation of works of art, and the tastes and requirements of a few thousand wealthy members of the middle class chiefly determine the nature of

the demand which the painter has to supply. The aristocracy are, as we are informed, not in these days buyers of pictures to anything like the extent of the merchants and manufacturers, whose splendid fortunes form so conspicuous a feature in our social system. This will help to account for the decline of pictures on classical subjects, which the one-sided education of the upper classes kept in vogue long after the period of their natural death had arrived. This remark must in nowise be understood as depreciating the grand merits of classical literature; but the poetic thoughts of modern times seldom take the forms of dead mythology, and it is surprising how little of the spirit of Greek or Roman history is communicated to the recipients of what is called "classical education" in old-fashioned schools. We are not surprised, therefore, that classical subjects present no important feature on the Royal Academy walls; and in examining what they do offer to our contemplation, let us first consider what Biblical subjects have done for our artists, and what the artists have done for them in return.

Looking through the catalogue, we find that Esau suggests the subject of one picture; "Jesus Christ, with the Disciples, on the way to Emmaus;" "The young Saviour observing the Hypocrites;" the miraculous restoration to life of the young damsel, whose story is recorded in the fifth chapter of Mark; "Esther's Banquet;" "Esther dressed in her royal apparel;" "The Devil Sowing Tares;" and "Elijah's Sacrifice;" a very unsatisfactory David, and a pair of extraordinary angels, forming the themes upon which, after divers fashions, other artists have pictorially discoursed. The two most remarkable of these pictures are by Millais, to whom belong "The Sowing of the Tares," and "Esther in her Royal Robes." The treatment of the first subject is a mixture of the literal and the grotesquely allegorical. An ugly, unpleasant-looking old man is engaged in scattering seeds on a curious looking soil, and beneath a coarsely-executed and impossible sky, which lights him up with a flowing dab of yellow paint, in strong contrast with some clouds that look like the leaden pigment with which house-painters often commence their work. The agricultural process in which the sinister-looking old gentleman is occupied appears to give satisfaction to a couple of snakes, whose slimy presence is presumed to assist in the allegorical meaning of the scene, and he is followed by a zoological curiosity, between a dog and a hyena, with a shambling gait and phosphorescent eyes. Some centuries ago, when the Father of Evil was popularly recognized in the delineations of mediæval legends, the parable of the tares might have presented itself to common imaginations in some such guise; but who is there in these days who

will be assisted by Mr. Millais' queer, quaint, and powerful caricature to form a higher or a deeper conception of the moral truth embodied in the narrative, than he would have done from simply reading it or hearing it read?

We are not impressed with the "Scenes from the Life of Christ" that stand next in our list. After all that has been done, it is, no doubt, amazingly difficult for any one to satisfy us with delineations of these subjects. Novelty in conception, dignity, and poetic truth in their treatment, are characteristics we want and seldom find.

Queen Esther is the theme of two pictures; one by Mr. Armitage represents the "Banquet of Wine," at which Haman makes supplication for his life. The treatment of this story does not convey the impression that Mr. Armitage was very deeply moved by it. It looks as if he regarded it as affording opportunity for depicting a richly-draped oriental group, and we look at it without any moral or intellectual excitation being the result. Out of the thousands who will look at it on the Academy walls, perhaps none will find that it has induced them to refer to the Scripture narrative on their return home. The second picture is by Millais, who brings before us a brilliant yellow silk dress, ornamented with rich and curious embroidery. The fashion may not be quite that of high life in Pekin, but it has a Chinese aspect, and had we seen it at the Crystal Palace, it would have seemed an appropriate companion of the rich and rare things from the Summer Palace of the "Central Flowery Land." But the features of the inhabitant of this gorgeous robe are not Chinese, so no such mistake ought to be made. True, after looking at the dress, you can see the lady, who is the accessory in the scene—the principal being undoubtedly the dress itself. Now, it will happen, even in the best society, that the tailor makes the man, and the dressmaker the woman; but our own—unartistic—recollection of the old story is that Queen Esther was of a different stamp, and we ask in an ideal portrait the charm of womanhood that subdued the savage monarch, and some evidence of the patriotic devotion that made her the benefactress of her race. Yellow silk, with the best embroidery, did not do the work the narrative ascribes to her, and we should not have associated the picture with any Jewish heroine at all. It is a wonderful portrait of a yellow dress, and nothing more.

The grandest of the Scripture subjects treated in the exhibition is "Elijah's Sacrifice," by Mr. A. Moore. We cannot in the least comprehend the theory he has formed of this scene. In Mendelssohn's sound painting it is sublime. The barbaric rites of the idolaters, the fervid piety and stern

enthusiasm of the Jews, are facts recalled from the past, and made parts of our actual and vital present in the strains of the Oratorio, but the artist only puzzles our eyes with ineffective grouping and monotonous tints.

Biblical subjects, then, are a failure in this exhibition. It ought not to be so, because they have the immense advantage of being known to all, and in their poetical ideal aspects are perfectly independent of the critical discussions that agitate and perplex our times.

Let us next look at the historical and political subjects upon which our artists' pencils have been engaged. Latest in the date of the scene, and foremost in attracting attention, is Mr. Frith's representation of the "Marriage of the Prince of Wales." The artist did not exercise any choice in the selection of this theme, and with all his skill he has only been able to add to previous proofs of the fact, that Court ceremonials, however interesting to spectators, have little to commend them to the artistic mind. With regard to other historical pictures, we may presume that their subjects were selected because they possessed some qualities of incident or suggestion which the painter desired. The list of pictures of this class is not long, and the mere recital of the titles suggests some curious thoughts. Lucknow and Cawnpore furnish Mr. Jones with themes from the Indian mutiny, which he proposes to work out on a larger scale. "The Battle of Edgehill," selecting the moment when Prince Rupert, aided by the desertion of Sir Faithful Fortescue from the Parliamentary ranks, makes a successful charge, supplies a text for Mr. Cooper. Mr. Wynfield represents the "Last Days of Elizabeth" when she was "mopish and melancholy"; Mr. Millais has a "Joan of Arc"; Mr. Ward tries the old story of "Rizzio's Murder," taking the time when Ruthven enters the little chamber at Holyrood, and says to the Queen, "Let your man come forth—he has been here too long."

Mr. Millais, in addition to the "Joan of Arc," gives us an ideal scene of the Romans leaving Britain. Mr. O'Neile depicts, after a fashion, the pretty incident of Canute stopping his boat to hear the monks of Ely sing. Mr. Storey exhibits Henry VIII. taking his part in public games; Mr. Clay shows Charles IX. surrounded by his courtiers, and instigated by Catherine de Medici to join in the massacre of the Protestants by firing at them out of the window; Mr. Lacy represents Garibaldi depositing a wreath on the tomb of Ugo Foscolo, at Chiswick. Mr. Prinsep takes his subject from the flight of Jane Shore; Madame Jerichau has a simple, pathetic picture of a wounded Dane attended by his betrothed; Mr. W. J. Grant portrays Marie Antoinette endeavouring to win one of the opposition

leaders by showing him her child asleep; Mr. Drummond gives an incident in the life of Claverhouse; Mr. Hayllar is inspired with "Queen Elizabeth's toothache;" Mr. Faed takes an incident from old border minstrelsy, and his picture—a very good one—is historical in spirit, if not in fact; Mr. Leslie discourses in pigments on the "Defence of Latham House."

Not one of these subjects indicate any particular research amongst recent writings on the part of the artists. Their pictures might have been painted at any time, from information picked up anyhow, and no one has any special tendency to stir up great thoughts, vindicate noble memories, or incite to lofty deeds. Within the last few years, a very powerful, and in many cases, novel light, has been thrown upon English and continental history by the labours of Froude, Mottley, Kirke, etc. Mottley's *Rise of the Dutch Republic* and *History of the Netherlands* are grand works, exciting to read, and abounding in vivid descriptions of scenes, not hackneyed, and full of human interest. Do our artists peruse none of these things? If the historical pictures of the present exhibition were all put together, who would be better for them, morally or intellectually? The two most striking pictures are "The Night of Rizzio's Murder," and "The Romans leaving Britain." In the former case the worthlessness of the victim, the dubious character of the Queen, the undoubted baseness of her husband, and the brutality of Ruthven, are not the elements out of which a picture intellectually or morally great could be made. The story is melodramatic rather than genuinely tragic, and it has long since become commonplace. Passing over the want of high purpose in this picture, we do not think it merits much praise upon æsthetic grounds. The lurid fire-light overpowering the numerous candles on the table is scarcely natural, and certainly not beautiful. The spectral-looking Ruthven conforms pretty closely with the story, as it has come down to us. Darnley looks mean enough for those who take the worst view of his wretched character; and Mary shows a mixture of disgust with her husband, anger at the intrusion, and alarm at its aspect, which is highly probable.

But why represent these things on canvas? As a domestic picture it is disagreeable, not redeemed by any pleasant harmonies of colour. It makes us feel that a supper party of loose people, intruded upon by a ruffian proposing to kill one of them, is a very unpleasant affair. Beyond this we find nothing to recompense the horror which an incipient murder excites.

Mr. Millais, in his work, has given us a very powerful, if not very pleasing, delineation of human feeling. A Roman soldier casts himself in a last embrace upon a British woman,

whom he has to leave behind, and her countenance is full of sternly-suppressed emotion of the bitterest kind. The scene is on the coast of Kent, the chalk cliffs stretch along the shore, and they are painted neither according to nature, nor after the pre-Raphaelite style of exaggerating detail. The grass is little like grass, the chalk little like chalk; but there is power in the figures and faces, so that with little of the beauty that ought to belong to a work of art to attract the eye, the visitor to the gallery is, nevertheless, a captive for the time, and what the artist has painted remains fixed upon the memory, even to the oyster-shell in the corner, that indicates the last Roman meal.

Next to historical subjects, biographical ones are most naturally considered, and the foremost of the few pictures belonging to this class is "The Early Career of Murillo," by J. Phillip, R.A. In the youthful days of the great Spanish artist, poverty compelled him to paint hasty pictures for sale at the weekly fair, "held in a broad street branching from the northern end of the old Alameda. This venerable market presents every Thursday an aspect which has changed but little since the days of Murillo. Fruit, vegetables, and coarse pottery, old clothes, old iron, still cover the ground as they did two centuries ago, when the unknown youth stood among gipsies, muleteers, and mendicant friars, selling for a few reals those productions of his early pencil for which royal collectors are ever ready to contend." No one can say that this is not a good subject for a picture. It stands out pictorially in the extract from *Stirling's Annals of Spanish Painters*, which we have given from the Academy catalogue. Human sympathy strongly attaches itself to the early struggles of the world's great men; and Mr. Phillip shows us, in the fine face and proud aspiration of the young artist, a promise of future fame, which seems also to impress itself on the rough picturesque critics who are laying down the law, as they contemplate a little piece which Murillo offers for sale. The grouping and accessories of this fine work are eminently picturesque; but there is a want of harmony amongst the various hues and shades of reds and greens in the middle and on the left of the work, which it would be well to correct.

Comparatively few pictures have been suggested by the writings of our poets, either ancient or modern. There is, of course, an Elaine, and there are two Mariana's from Tennyson's well-known lay. Southey's *Battle of Blenheim*, with its refrain, "'Twas a glorious victory," suggests another work. Lord Derby's *Homer* has caused Mr. Leighton to give us a Helen, whom we cannot fancy the Greeks would have been so unwise as to seek to regain through many a bitter fight and a

protracted siege. Milton's *Penseroso* gives a title to one piece, and Tennyson's lines—

> "O swallow flying from the golden woods,
> Fly to her, and pipe, and woo her, and make her mine,
> And tell her—tell her—that I follow thee,"

have caused Millais to paint one of the most truthful and beautiful things he has yet achieved. A young girl in a black dress, with a blue bodice, looks and listens eagerly to a swallow who brings her lover's message from the "golden woods." For a pleasant wonder Mr. Millais did not choose an ugly model for his lady, and the antique furniture of the room, with the lights glinting on the carved and polished chair—all are in exquisite taste. One or two Shakspeare pieces we did not think successful. Browning—whose works are rich in themes for true artists—has not received a single illustration; but Mrs. Browning, whose writings would well repay any artist's study, has found in Mrs. F. L. Bridell an elegant interpreter for her pretty story of the "Romance of the Swan's Nest." "Little Ellie" is sitting musing on her discovery, and indulging in childhood's romantic dreams.

Thus our artists seem to have got as little from the poets as they did from the historians. Let us now survey their labours from another point of view.

Scenes of oriental life are conspicuous in this exhibition, and in the first rank of these is a work which, for many rare qualities, is the finest in the whole collection. That we mean Mr. Goodall's "Rising of the Nile" will be obvious to all readers who have seen the pictures of this year. When the fertilizing floods of the Egyptian river exceed, by a few feet, their average rise, many villages are submerged, and desolation and ruin await their surviving inhabitants. Mr. Goodall represents the waters reaching such a village, and a family making its escape. An old man with a green turban, seated on a refractory camel, urges the affrighted beast to make the last effort by which safety will be gained. A dark-skinned servant gives his aid. In front is a little girl in a loose pearl-yellow robe, with a green sheen upon it; she holds a lamb in her arms. Near her is a woman carrying a baby; her outer garment is of a rich and varied purple hue, the under one of a singularly fine deep tone of crimson, mostly in shadow, but flashing like a gem where its silken tassels catch the light. An old, bedridden man is carried by picturesque figures, and several other characters fill up the scene. This splendid work is remarkable for several peculiarities. The time is early morning, and the humid sky diffuses a cold, clear light, differing widely from the gorgeous, sunset hues for which

Egypt is famous, and which we lately endeavoured to portray. All the figures are in comparative shadow with the bright light behind the entire group. Such a treatment offers picturesque advantages at the expense of great difficulties, which latter are admirably surmounted. Under such circumstances, richness of effect and brilliancy must depend entirely on the skill with which the colours are contrasted and harmonized. Only one little touch of white is introduced, and a magical use is made of greens, purples, crimsons, blues, and yellows. Those who fancy that the colourist has nothing to do but bring strikingly opposed tints into juxtaposition, should study the immense variety of tones and hues that are introduced into the draperies of this piece. The dress, that at first sight would be pronounced blue, is in reality of very complicated and varied hue, and no part of the drapery is wanting in elaboration of colour harmony. It is this, quite as much as the splendid drawing, that makes the "Rising of the Nile" a truly great work—to our mind far exceeding anything Mr. Goodall has hitherto accomplished. We do not wish to make unfair comparisons; but let any one who has an eye for colour, go from this picture to the fine painting representing Murillo's boyhood, and he will then see how great an advantage the "Rising of the Nile" possesses over the other important work, because more pains have been taken to fill up the scale of colour, and give that harmonious completeness which affords a permanent sensation of delight.

Another striking oriental picture, but of a much lower grade than the "Rising of the Nile," is the "Turkish School at Cairo," by J. F. Lewis, R.A. elect. The colouring is brilliant, but scarcely harmonious, and the human interest is secondary—the draperies and accessories constituting the artist's real theme.

Domestic scenes in various ranks of life supply subjects for far too many pieces for us to enumerate. In dealing with cottage life, our artists, with scarcely an exception, commit the common fault of treating their inmates as objects to be done into paint, not as persons having joys, sorrows, temptations, and triumphs like themselves. The boards and tiles, the pots and pans may be unexceptionable, but the sentiment is wanting. We might, however, mention several delineations of domestic life that are pleasing and meritorious as far as they go; one of the prettiest in conception is the "Old Maid"—two young girls, dressed in old style, are playing at cards the game of "Old Maid," and the loser exclaims, "Maggie, you're cheating." Mr. Archer is the artist from whom this clever picture comes. Webster's "My Back Kitchen" is admirable for its truthfulness to fact and to a conception void of the poetic, and if we may name Sir

E. Landseer's "Connoisseurs" in this series, it would be placed at their head. The artist is making a sketch, and two dogs, looking over his shoulders, are criticising the work, evidently with more intelligence than human connoisseurs often display.

Landscapes form the last great category to which we shall allude; and among the most elegant and pleasing is "The Village Smithy," by Creswick, who has in this instance managed to forget the mannerism which so sadly detracts from the average merit of his works. A landscape ought to be beautiful or it is not worth painting, and it ought especially to exhibit those charms of light and colour which are evanescent in their effects, which the true artist should be the first to recognize, and which he only has the power to retain. Instead of contenting himself with somewhat tame green trees, over-polished rocks, and soapy streams, Mr. Creswick has this year given us a beautiful effect of contrasted light. A cool evening sky, with a crescent moon, graceful trees, and a flowing river, contrast exquisitely with the red light from the village smithy. The delineation is at once natural and poetic. All of us may have seen something of the kind, and fancy clings fondly to such pleasantly-tinted recollections. We should all like this picture, and are half-vexed that, with so many other good things, "private property" should swallow it up. The thought makes us exclaim with Proudhon, *La propriété c'est le vol.* The Linnells are of course in the landscape series; and the "Shepherd's Mount," by W. Linnell, is very fine. What we regret with them, and many other artists, is that they stereotype a manner. You see fiery skies of a particular red tint, corn of golden brown hue, and blue distances in certain combination, and you are sure it is a Linnell—father or sons. Nature cannot look so much alike to this clever family. She is infinitely varied; why cannot they avoid travelling on one path till they have made a rut?

We know not under what head to place the very mannered and very popular productions of Mr. Hook. In the true artistic sense of the term they are not landscapes, but *Hookscapes.* He forms a theory of the sort of rock and water that will go with his brown faced men and boys. It is not like nature, nor is it an artist's bettering of that which he sees. Clever it undoubtedly is—sell it undoubtedly does; but it has grave faults in the eyes of those who love the actual as seen in an ideal light.

We have brought our examination to a conclusion. We have made no attempt to note all the pictures in the several series that might deserve comment. Our object has been to arrive at some notion of the state of the artist-mind, from its choice and treatment of subjects for pictorial work. We find, as all honest critics must do, much to praise and be proud of, but

we think we are not wrong in affirming that a want of literary culture is on the whole noticeable and regrettable. It is manifested in the little that our artists seem to learn from our poets and our historians, in the poor view they so often take of life and its realities, and in the tendency evinced in so many landscapes to avoid rather than to seek a comprehension of the varied effects which nature produces and exhibits, and to take refuge in a mannerism as soon as any particular mode of treatment has been discovered that conduces to immediate gain. The artist ought to be one of the highest of the people's teachers. When more artists take their true position, an analysis of the subjects of a thousand pictures will give a very different result.

DR. DRAPER'S TELESCOPE.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

It is gratifying to observe that, amidst all the calamities and distresses and confusion of a most unhappy civil war, the studies of peace have not been wholly lost to sight. A remarkable instance of this is afforded by the recent appearance, among the publications of the American Smithsonian Institution, of a very interesting and valuable memoir, "On the Construction of a Silvered Glass Telescope, 15½ inches in aperture, and its use in celestial photography, by Henry Draper, M.D., Professor of Natural Science in the University of New York." A copy of this, through the courtesy of the author, being now in my hands, I have thought that some account of its contents might prove interesting, especially at a time when silvered glass specula are attracting some attention in England, and (unless we are much mistaken) are likely to be more generally known and valued as most important aids to the progress of observation.

The opening sentence of this memoir requires, however, we venture to think, a little qualification. "The construction of a reflecting telescope capable of showing every celestial object now known," Dr. Draper tells us, "is not a very difficult task." We should have no hesitation in expunging the negative here, unless it were permitted to add, "when study, and labour, and ingenuity, and perseverance have been brought to bear upon it, equal to those displayed by Dr. Draper." His subsequent remark is of more universal application. "The cost of materials is but trifling compared with the result

obtained; and I can see no reason why silvered glass instruments should not come into general use among amateurs. The future hopes of astronomy lie in the multitude of observers, and in the concentration of the action of many minds." His first idea was derived from an examination, in 1857, of Lord Rosse's great reflector, and of the machinery by which it was perfected; and on his return home in the following year, he resolved to construct a similar, though smaller instrument, larger, however, than any in America, and adapted to celestial photography. A metal speculum was first completed, but was split in two during the winter of 1860 by the expansion of a few drops of water that became frozen in the supporting case, and his attention was then, at Sir John Herschel's suggestion, turned to silvered glass mirrors, as reflecting more than 90 per cent. of incident light, with only $\frac{1}{8}$th of the weight of metal. The year 1861 was occupied in overcoming the difficulties of grinding and polishing three 15½-inch discs of glass, as well as a variety of smaller pieces. Three similar mirrors were found almost essential, as two would often be so much alike that a third was necessary to gain a further step in advance. One was made to acquire a parabolic figure (see INTELLECTUAL OBSERVER, iii. 213), and bore a power of 1000. The winter was spent in perfecting the art of silvering, and studying photographic processes. A large portion of 1862 was spent with a regiment in a campaign in Virginia, but in the autumn sand-clocks and clepsydras of various kinds were made, and the driving mechanism attained great excellence. During the winter the art of communicating the parabolic figure by Foucault's method was acquired, and two 15½-inch mirrors, and two of 9 inches, for enlarging photographs, were completed. The greater part of 1863 was spent in lunar and planetary photography, and the enlargement of negatives, some of which were magnified to three feet in diameter. Two specula of 15½ inches were also completed, ground to an oblique focus for front view. "This work," he adds—and any one with very little experience may judge of the immense amount of toil involved—"has all been accomplished in the intervals of professional labour." Many of the expedients adopted in the working, which are detailed at full length, are strikingly characteristic of ingenuity as well as perseverance. To avoid the tediousness of grinding out defects in a metal surface, they were "stopped out," after the manner of engravers, and the uncovered space corroded away by the action of nitro-hydrochloric acid; by a similar mode, the strength of the acid being graduated in separate zones towards the edge, an increase of 15 inches in focal length was gained. The grinder and mirror were at another time included in a voltaic circuit to abridge

the grinding process, and an idea was entertained of saving much weight by electrotyping a brass mirror with speculum metal. When he commenced operations with glass, he had to polish with his own hands more than 100 mirrors of various sizes, from 19 inches to $\frac{1}{4}$ inch, and to experience very frequent failures for three years before he was able to produce large surfaces certainly and speedily. His labour would have been much diminished, inasmuch as he would have been spared the causeless condemnation of many fine mirrors, as well as the working of some *square* ones, had he become earlier aware of an important fact respecting the rigidity of the material.* Generally speaking, a sheet of glass, even when very thick, can hardly be set on edge without so much flexure as to render it optically worthless; but fortunately, in every disc that he tried, there was one diameter on either end of which it might stand without harm. On turning a disc of $15\frac{1}{2}$ inches, with a thickness of $1\frac{1}{4}$ inch, one quarter round, it could hardly be realized that the surface was the same: 90° more restored it to its original defining power; and this effect was found to be independent of any irregularity on the edge of the disc and of the mode of support. Dr. Draper refers it with great probability to the structure of the glass, resulting from its having been subjected to rolling pressure. A similar irregularity of structure is known to obtain in many large object-glasses, and Dr. Draper specifies the great achromatic by Cauchoix, presented by the late Duke of Northumberland to the University of Cambridge, as having had its lenses turned round by Mr. Airy in mounting, for this reason. Short's Gregorian specula, too, were always marked on the same account. The strange deformations of image produced by heat, even by the warmth of the hand for a few seconds, are described and represented. From such distortions the speculum would not recover in ten minutes, and the error would be rendered permanent by repolishing in that condition; and so injurious may such causes, even in a lesser degree, prove during the delicate process of the final correction of the spherical error, that "a current of cold or warm air, a gleam of sunlight, the close approach of some person, an unguarded touch, the application of cold water injudiciously, will ruin the labour of days." He found it a matter of not unfrequent occurrence that a speculum would perform much better with rays of a certain amount of obliquity,† deviating from 2° to 3° from the axis. It is obvious

* In examining and testing last year some fine 8-inch specula of Mr. With's workmanship, I had independently ascertained this peculiarity, so far as a *best position* for each was concerned, but I stopped short of Dr. Draper's discovery o a regular *axis of rigidity*.

† I became acquainted with this fact many years ago, when working metals for a small Newtonian reflector.

that if this peculiar form could be produced at will, and to an adequate degree, it would render the Lemairean, or front view telescope, perfect. Dr. D., however, found that the image was never quite as fine as in the usual kind of mirrors. A letter of Maskelyne subsequently came under his notice, in which he describes a very great improvement effected in a 6-foot reflector by Short, by inclining the large speculum $2\frac{1}{2}°$, and remarks very reasonably that "probably it will be found that this circumstance is by no means peculiar to this telescope;" a hint which may be worthy of the consideration of the possessors of reflectors. Such surfaces require to be reground, or "re-fined," *i.e.*, finished with the finest emery, to get rid of this obliquity, as repolishing, though occasionally successful in a few minutes, will not always effect it; the attempt failed in one instance though continued for $13\frac{1}{2}$ hours.

The modes of forming the requisite tools, of preparing emery, of grinding, polishing, testing (by Foucault's mode), and silvering the surface, are somewhat too technical to find a place here, but some interesting facts are worthy of being referred to. Such is the effect produced by the removal from a cast-iron tool, $15\frac{1}{2}$ inches in diameter, divided into $\frac{3}{4}$ inch squares, like a chessboard, of every alternate square by an acid. Though the corrosion extended only to a very slight depth, it flattened the curvature of the tool $7\frac{3}{4}$ inches. "This shows what a state of tension and compression there must be in such a mass, when the removal of a film of metal, $\frac{1}{50}$th of an inch thick, here and there, from one surface, causes so great a change." Another important remark is, how injurious an atmospheric disturbance is set up by the intermixture of currents of warm air from the observer's person with the rays falling on or reflected from the mirror—an observation which I made many years ago, and which any one may test by directing a Newtonian to any bright object, and placing one hand beneath the aperture, while an eye-piece held in the other hand, and applied to the eye, is carried back a considerable distance, so as to obtain a very long focus, and render the ascending currents more visible. It has not, I believe, been generally remarked how prejudicial an effect this must have on definition in the front-view reflector, and it would be a worthy object of attention to remove the evil by the interposition of some non-conducting shield.

A full trial was given to no less than seven machines, on the principles employed by Lord Rosse and Lassell, with modifications of his own. The prime mover, called the "foot-power," was a very ingenious contrivance, in which very little force is lost in overcoming friction, and which is frequently employed in America for dairy use. Dr, D. himself

generally walked in his own, and has travelled some days, during five hours, more than ten miles. It consists of an endless band of short transverse boards or "treads," interlocking so as to form a platform to tread upon, which will not yield downwards on its upper side, but hangs loose in the return half beneath, and passing over wheels and rollers at either end. This succession of boards, having one end a little higher than the other, runs downwards as soon as a weight is placed upon it, and communicates motion to a large wheel on the axle of the one over which it turns, and through it to any connected machinery. Being placed between a handrail on either side, it offers the appearance of a little narrow bridge, as over a ditch, composed of transverse boards, on which the mover may walk all day without getting a step forward. It is, in fact, a species of treadmill, of a much more pleasant construction.

The mode of giving a parabolic figure finally preferred by Dr. D., is that of "local retouches," in which the edge of a spherical mirror is flattened, or, which he thinks preferable, the centre is bored out deeper, by appropriate polishers of curvatures differing slightly from that of the original tool on which it was wrought. This method, as invented by M. Léon Foucault, at Paris, was employed by hand, but has been practised by Dr. D. with suitable machinery, and with excellent results; his great specula, thus finished, bearing a power of 1200, and dividing the celebrated test-pair γ^2 *Addromedæ;* while so great is the light-collecting power of $15\frac{1}{2}$ inches, that the companion of *Wega* can be perceived even with the unsilvered surface; some portions of the moon are even more visible than after silvering—a hint worth notice. When silvered, the quantity of lunar light is so overpowering as to impair for a long time the vision of an eye placed at the focus. Several modes of silvering were tried by Dr. D.—some devised by himself. Foucault's proved uncertain in its results; that of Cimeg, with tartrate of potash and soda, for looking-glasses, modified so as to fit the silver for being polished on the reverse side, he found superior to any, and in using it, "never on any occasion failed to secure bright, hard, and in every respect perfect films." Their thickness is about $\frac{1}{200,000}$ of an inch—nearly the same with that of gold-leaf of equal transparency—the sun appearing through the silver of a light blue tint. Variations in its thickness are consequently only small fractions of that fraction, and of no optical moment whatever. It tarnishes quickly if exposed to sulphuretted hydrogen—a defect which has been avoided in the English process—and it may be split up into fissures by damp; but heat does not affect it, and it is generally very enduring. "I have

some," the doctor says, "which have been used as diagonal reflectors in the Newtonian, and have been exposed during a large part of the day to the heat of the sun concentrated by the $15\frac{1}{2}$ inch mirror. These small mirrors are never covered, and yet the one now in the telescope has been there a year, and has had the dusty film, like that which accumulates on glass, polished off it a dozen times."

Besides other interesting optical particulars, the memoir contains many directions for the successful practice of celestial photography, some of which might be found equally valuable for terrestrial purposes; and to these we may advert on a future occasion; adopting for the present the author's closing remarks: "In concluding this account of a Silvered Glass Telescope, I may answer an inquiry which, doubtless, will be made by many of my readers, whether this kind of reflector can ever rival in size and efficiency such great metallic specula as those of Sir W. Herschel, the Earl of Rosse, and Mr. Lassell? My experience in the matter, strengthened by the recent successful attempt of M. Foucault to figure such a surface more than thirty inches in diameter, assures me that not only can the four and six feet telescopes of those astronomers be equalled, but even excelled. It is merely an affair of expense and patience. I hope that the minute details I have given in this paper may lead some one to make the effort."

HYSTERO-DEMONOPATHY IN SAVOY.

The term *Hystero-demonopathy* has been invented by medical writers to designate a form of hysteria in which the patients conceive themselves subjects of demoniacal possession. For the spread of disorders of this class it is necessary that the victims of the malady should be ignorant persons, or, at any rate, not having received any practical scientific training; that the locality should be more or less isolated from the busy world and that sharpening of the intellect and firmness of moral character which results from the healthy exercise of faculties under civilized conditions; and lastly, that there should be a general belief in particular forms of superstition favourable to the delusions of those whom the disease attacks. Cases of this kind are very interesting in a scientific point of view. There must be a certain *substratum* of positive physical disorder, and there must be a mental disorder co-operating with the former, exaggerating its violence, and giving it a special direction. During the middle ages such epidemics were common, and they are probably much more frequent now than is generally supposed; but the difference is, that whereas in former times of greater ignorance, less security for life and property, and less regular industry, they made their appearance in important localities, they are now chiefly confined to districts that have escaped the progressive influences of our time, and it is only by accident that any person of adequate knowledge studies the phenomena, and makes them the subject of a report.

We learn by an article in the *Revue Moderne*, that an epidemic of the kind described is prevalent in a place called Morzine, in Savoy. The superstitious folks declared that the devil possessed many of the inhabitants of this place, and M. J. Tissot, who writes the article from which our information is derived, proceeded to the spot. It appears that in 1857, a priest, born at Morzine, who tried to persuade the people that the devil had nothing to do with their illness, was suspected of having cast a diabolical spell over some of the young women. He was compelled to leave; but before departing they believed he communicated the fatal secret to certain individuals who continued the evil work. So the clergy and the laity fancied, and the local medical science, instead of correcting the delusion, became a convert to it. It was affirmed that exorcism had succeeded in a similar case that had occurred in the neighbourhood of Morzine, and for a time other means were abandoned in favour of a remedy that accorded with the state of the village mind. Witnesses that would have been accepted as

trustworthy in ordinary affairs, declared that the devil enabled the possessed to climb fir-trees like squirrels, and to stand on their heads when they reached the topmost branches, which, however delicate, were not bent under their weight. It was also affirmed that they manifested prodigious strength and remarkable eloquence, speaking Latin, German, and Arabic, which they had never learnt, describing faithfully battles they had never seen, and miraculously beholding from Morzine, transactions that took place at Geneva. In utter contradiction to their usual pious habits they blasphemed all holy things, and had a horror of religious exercises. They spoke of themselves in the third person—"he or she did so," which was explained to mean that the devil was speaking for them, and they were believed to know the secret thoughts of individuals whom they had never seen before.

These strange stories induced M. Tissot to visit the place, which he found occupied by a detachment of infantry and a brigade of *gensdarmerie*, sent by the government to maintain order, and with instructions to forward victims of the malady who were attacked in church or in public, to Thonon, Nyon, Cluny, and other places somewhat removed from the influences operating at Morzine. Fortunately superstition decided that the devil was not permitted to exercise his powers beyond Morzine, and the patients soon got well under the care of the government authorities.

M. Tissot visited a woman and her daughter who were said to be subject to possession. The latter, a girl of eighteen, had been sent to Cluny, and since her return had not experienced a convulsive crisis. She seemed out of health, and complained of pain in the epigastric region, and also of the *globus hystericus,* which makes sufferers fancy their hearts are coming up into their throats. Although better than she had been, she was not able to go to church, nor to pray, and the sound of the church bell was painful to her! She accompanied M. Tissot to her mother, and both spoke as if quite certain that they were possessed. The mother soon had an attack. Her arms were thrown backwards and forwards, the head thrown back on to the shoulders, and her body was agitated as if by a series of violent electric shocks. The convulsions were soon over, only lasting about a minute.

The following day, M. Tissot paid them a second visit, taking with him some wine and some pastry, in which he had put a little holy water taken by himself from the vessel in the church. When he arrived at the cottage, the party consisted of the hysterical mother and daughter, a little girl who watched their cattle up the mountain, the grandfather—an old soldier in the French armies—and his son, married to the

eldest of the women, and father of the two girls. They had received a kind, but injudicious letter from a nun in the establishment at Cluny, in which a good deal was said about the demon. M. Tissot read this aloud, till he came to passages he thought undesirable, when he stopped and returned the letter with an incredulous air. This, however, brought the conversation back to the subject he desired to avoid, and the mother had another attack like that of the previous day. The other members of the family exclaimed that nothing but exorcisms would suffice. M. Tissot reminded them that when exorcisms had been general, until forbidden by the bishop, the cases were more numerous. At first the suffering woman made no reply; but her convulsions grew more violent, and she began to declaim with great volubility. The devil seemed to speak through her mouth; he spoke in his own name and in that of the daughter, who would not leave her mother. After heartily abusing Mr. Tissot, she experienced eructation, and took some water, which seemed to calm her. During the paroxysm of this fit, she struck the table with her fists as if she would break it to pieces; but at its termination her hands were not particularly hot, nor was her pulse remarkably rapid or strong. M. Tissot then walked away with the old man, who strongly believed in the alleged possession, which his visitor attempted to counteract by telling of his trick with the holy water, which he was bound to believe the devil would have detected, and not allowed the woman to swallow.

M. Tissot states that this epidemic had at first a purely hysterical character, from which it passed through stages of convulsion and ecstasy to that of demonopathy.

For a time the judicious measures adopted by the Minister of the Interior were successful, and from a hundred and twenty patients in the spring of 1862, the number fell in the autumn to perhaps less than twenty. In 1863 the military force left Morzine, as it was hoped that the disorder had finally abated; but M. Tissot has recently received a letter informing him that a fresh outbreak has occurred, commencing at the announcement of a confirmation, and becoming so violent when the bishop arrived as to occasion alarming disorders in the church. The poor people who thought themselves possessed uttered frightful cries and blasphemies, tried to spit upon the bishop and take from him his pastoral ring. When the bishop pronounced his benediction the uproar became frightful, and occasioned the utmost consternation.

It is remarkable that only two men have been attacked by this epidemic, and that, with about ten exceptions, the patients have been women from eighteen to twenty-five years old.

The authorities are endeavouring to divert the minds of

the people, and it is hoped that when a road is finished between Thonon and Morzine, they will have more useful occupation, and come into greater contact with persons more reasonable than themselves.

HEIGHT OF THE AURORAL ARCH OF MARCH 20, 1865.

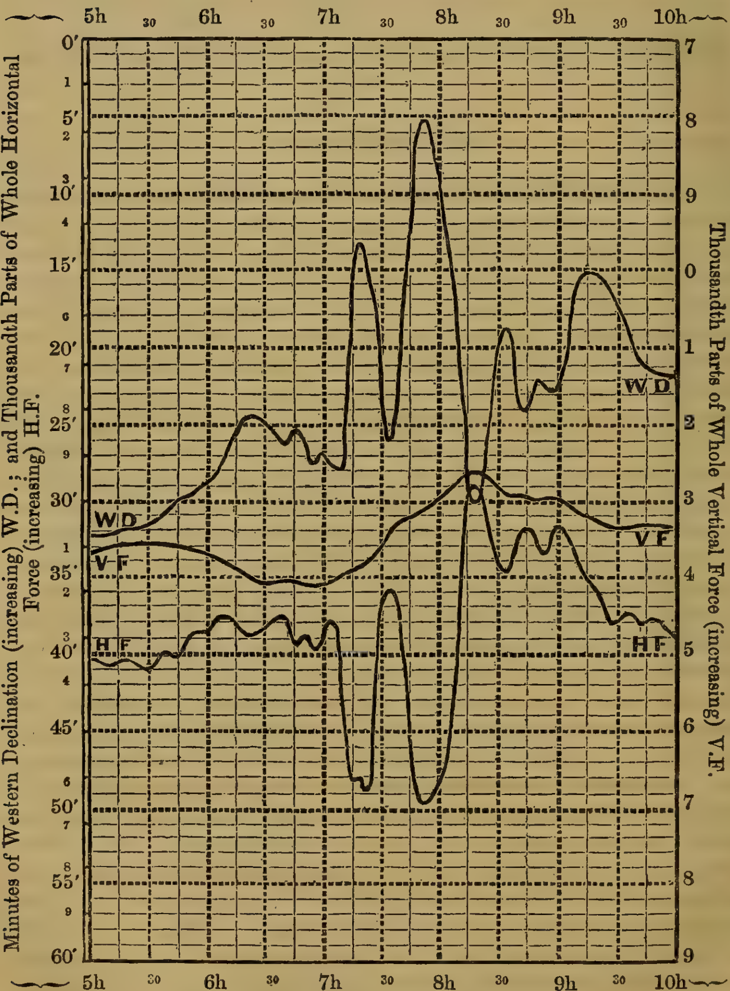
BY A. S. HERSCHEL, B.A.

SINCE the laws of meteorology have become better known, and the practice of recording meteorological observations more widely extended, the appearance of the aurora has attracted attention, more particularly in its connection with the local variations of the magnetic needle. When the aurora is observed from different points of view, it is important to note especially the moments when individual phases of its principal features occur, which may afterwards be connected with the motions of the magnetic needle. A connection should be established with the daily telegraphic signals, to identify the time with Greenwich, Edinburgh, or Dublin, at the first of which observatories self-registered photographs of the movements of the magnetic needles are recorded continuously, and are capable of being compared afterwards with observations of auroras, when these have been referred to standard Greenwich time.

On the 20th of March last, at 8h. 20m. p.m. G. M. T., an auroral arch at Manchester was observed by Mr. Baxendell, spanning the zenith from west to east, which about twenty minutes later had changed its position very sensibly, the western portion having moved in a southerly, and the eastern portion in a northerly direction. At the same time an extensive magnetic disturbance was observed, the index of a delicate instrument constructed by Dr. Joule for showing, rapidly, minute changes of magnetic declination being driven entirely out of the field of view. At Hawkhurst the luminous arch was first observed at G. M. T. 7h. 50m. p.m. It disappeared completely at 8h. 30m. p.m. During this short space of time the curves of the magnetometers at Greenwich show that the needle moved eastwards, and back again, through nearly half a degree of an arc of a circle. In a vertical sense, the needles remained nearly unaffected or oscillated in a less degree (see Fig. 1). Such an effect upon the magnetometers would be produced by a galvanic current, at the summit of the atmosphere, flowing from north to south, over

the needles, *in the direction of the magnetic meridian.* It appears not improbable that the arch was one segment of a luminous *stratified* discharge. An interchange of electricity

Fig. 1. Register of Greenwich Magnetometers.



between the north and south hemispheres of the earth, in the form of an escape of galvanic electricity from the borders of the icy regions, was an explanation of the aurora originally

proposed by Fisher and (many years later) by De la Rive. Whether the principle of stratified discharges is adequate or insufficient to explain these great "semi-great-circles" that pass in succession over our heads, must be left to magnetologists to decide; for whenever there is aurora there is *infallibly* large magnetic disturbance.

Shortly after, or simultaneously with the disappearance of the arch, a luminous glow appeared upon the north-west horizon at Hawkhurst, Burton, Manchester, and other places; which continued from 8h. 40m. p.m. to 9h. 25m. p.m., and then gave place to a display of auroral streamers, observed at Burton-on-Trent and Windermere. This part of the display

Fig. 2. Change of Position in an Auroral Arch, March 20th, 1865.

appears to have been too distant to affect the magnetometers at Greenwich.

It is important to note particularly the position in the heavens occupied by the luminous arch (or other principal portions) of an aurora at any time and place, as it is by a comparison of these with other observations of a similar nature recorded elsewhere that the distance of the meteor from the earth can be calculated. The luminous arc observed at Hawkhurst, from 7h. 50m. p.m., to 8h. 30m. p.m., on the 20th of March, appeared as a narrow, well defined band of

milky light, four degrees wide, and considerably wider and brighter at last towards the western extremity. At that part the upper margin descended abruptly to meet the lower margin at the horizon, the lower margin itself presenting an unbroken and even curve from horizon to horizon. At 8h. 10m. p.m. the brightest or medial line of the arch (which was very near the lower margin) passed across the stars κ *Cygni*, and λ, π *Andromedæ*, from a point in the east horizon below *Corona*, to a point in the west horizon below the head of *Aries*, where the lower margin was met by the upper margin descending, from an altitude of five or six degrees, perpendicularly to the horizon. The upper margin was diffuse at all parts excepting near the western extremity, where the light was most intense, contrasting strangely with the pale, narrow riband of white light stretched out to the horizon in the east. In this position the arch continued stationary from 7h. 50m. p.m., to 8h. 20m. p.m., or nearly so; but at 8h. 25m. p.m. it was observed that the western extremity had risen five or six degrees from the horizon, the eastern extremity at the same time remaining unmoved, and gradually growing fainter. The medial or brightest line of the arch now passed through the stars ι *Herculis*, δ *Cephei*, β *Andromedæ*, and a point as far from β *Arietis*, as β from a *Arietis*.

By comparing these observations with observations of a similar nature recorded elsewhere, some idea of the height of the arch above the earth may be obtained. At Burton-on-Trent the luminous arc was first perceived at 7h. 50m., at an altitude of 45° above the north horizon, and at the end of fifteen minutes the altitude had increased to 60°. This is an indication, which cannot be mistaken, of the drift of the phenomenon (at one time of its appearance) bodily towards the south. At one time of its visibility it was nearly vertical over Windermere, and at another time nearly vertical over Manchester. Between these places the southward drift must have taken place. It was succeeded by an apparent elevation of the western extremity of the arch at Hawkhurst, and by a revolution of the arch, observed at all places, by which the western extremity was brought nearer to Hawkhurst, but the eastern extremity retreated towards the north. (See Fig. 1.)

Between 8h. and 8h. 30m. p.m. the arch passed over Windermere, and extended in length from the tail-stars of *Ursa Major* in the east, to between the *Pleiades* and *Venus* in the west. Comparing with this the first observation at Hawkhurst, where for a long time the arch was nearly stationary, it appears that at this time the light floated over Sca-fell at a height of 105 miles, and over Durham at a height of 110 miles, declining to a height of 81 miles over the North Sea, at one extremity, and

at the other extremity to a height of 77 miles over Ireland, a short distance inland from Louth, upon the Irish coast. (See Fig. 2.)

At 8h. 20m. p.m. the arch was nearly vertical at Manchester, extending from between ϵ *Tauri* and the *Pleiades*, across *Capella*, and across *a Ursæ Majoris*, to ϵ *Bootis*. As, soon after this time, the position of the arch underwent a change, by revolution in a direction contrary to the sun or to the hands of a watch, it may be supposed that at the time of the second observation at Hawkhurst (8h. 25m. p.m.) the apparent position of the medial line at Manchester had advanced to ϵ *Tauri* in one direction, and three or four degrees north of ϵ *Bootis* in the other. The second observation at Hawkhurst, compared with that at Manchester, gives nearly the same height as before—namely, the height of the centre 108 miles over Preston, in Lancashire, and the height of the two extremities, 75 miles over the North Sea, and 90 miles over the Irish Channel between Milford Haven and Queenstown. (See Fig. 2.)

The apparent flexure of the luminous arc at Hawkhurst, where it was seen in profile, was *greater* than what would arise from exact conformity of the arch to the curvature of the earth. This circumstance of a greater distance from the earth at the centre of the arch than at the two extremities, might lead to a different view of the constitution of the arch from that already advanced from the movement of the magnetic needle. It might, for example, be inferred that the arch was occasioned by a current of galvanic electricity flowing across the magnetic meridian, from the atmosphere of Denmark to the atmosphere of Ireland, or the reverse (see Fig. 2), and seeking the line of least resistance by rising to a summit in the atmosphere; the small change of vertical force compared with the great change of horizontal force, seen in the curves of the magnetometers (Fig. 1), appears to favour this conclusion. To establish the result of a greater height at the centre than at the two extremities as a general condition of their form, would require repeated observations, and these arcs are, unfortunately, numbered among the rarer features of the Aurora Borealis.

The following heights of three auroral arches, calculated by Dr. Dalton, are taken from the *Philosophical Transactions* for 1828, where they were pointed out to me since writing the above description.

(1). 1819, October 17th. Height between 100 and 102 miles, observed at Keswick and Gosport.

(2). 1826, March 29th. Height between 100 and 110 miles, observed at Jedburgh and Warrington.

(3). 1827, December 27th. Height nearly 100 miles, observed at Kendal and Manchester.

Regarding the near agreement with one another of these results, Dr. Dalton has the following remark:—"I am induced to believe that these luminous arches of the aurora, which occasionally appear stretching from east to west across the magnetic meridian, are all of the same height, *and that height about one hundred miles.*" The near agreement of this conjecture with the height of the auroral arch observed on the evening of the 20th of March confirms the general stability of their appearance, and makes the uniformity of their effect, as observed in the movements of the magnetic needle, a most interesting subject of inquiry.

THE AURORAL ARCH OF MARCH 20, 1865, AS SEEN IN IRELAND.

BY THE HON. MRS. WARD.

As I find that a late number of this magazine (that of April, 1865) contains some descriptions of an auroral arch seen in Scotland on February 15th, I am tempted to send two accounts of a similar phenomenon, seen on March 20th, together with my own observations upon it, at Bellair, King's county, lat. 53° 20′ 17″ and long. 7° 44′ W.

I am constrained, however, to describe it in the tone of the writer who, as stated in the article above referred to, "exclaimed," concerning the aurora of February 15th, that its wondrous beauty could hardly be described, and that it seemed to lead "onward to the golden gates of heaven." Exclamation must be employed in describing what I saw at ten minutes before eight on the evening of March 20th.*

The afternoon had been clear, a light wind blowing from the east. Several minutes before sunset I had detected Venus as a glittering point on the pale blue sky, and had occasionally glanced at the brilliant planet during the deepening twilight. About ten minutes before eight o'clock, I thought on looking towards the south, that the air had an unusually luminous aspect. The moon had not risen—surely the planet Venus could not throw such a light. I descended the doorsteps, and stood astonished! The light was, in short,

* This denotes Dublin time, as kept at the neighbouring railway station; the hour by Greenwich time was about 8h. 15m., and the aurora had probably been visible several minutes before I observed it.

caused by a magnificent auroral arch, commencing west of the constellation Taurus, rising to a great height, though not actually to the zenith, and terminating close to Arcturus, at a few degrees over the eastern horizon.

Its shape was of an extraordinary regularity, like a broad path of white light, and it was so intensely *visible,* and so sharply defined, that it occurred to me to compare it to the brazen meridian of a globe, realized as a luminous band. I viewed it at first with feelings not unmixed with alarm, yet more with deep admiration; then the thought, "It will soon fade away," led me to make the attempt to look at it with calmness, and note some points to impress on the memory.

But "look at it" is scarcely the expression to use. It was so large, the eye could not view it as a whole, but progressively, by following it along its sweep of *a hundred and forty degrees.*

It remained visible during about half an hour from the time when I first caught sight of it. When it disappeared, I began at once to write down what I had observed, and marked its place with black paint on the celestial globe. The notes made were to the following effect:—

When I first saw it, its left margin (southern) was much brighter than its right, especially at the western extremity, that is, near Taurus. Its breadth there was greatest, viz., about 8°. On turning round quickly and directing attention to the eastern end, that is, near Arcturus, I could observe it was narrower there, but could not trace any appearance of narrowing by carrying the eye along the arch from the western to the eastern end, as its sides then appeared to be parallel to each other. The general stillness of the arch was remarkable; there were, however, slight exceptions. A distinctly-marked dark cleft appeared in it, running up its centre lengthwise from the western end, to about its highest point. This cleft soon became less marked, seeming to close up abruptly. Another movement was to be observed for a few moments along the whole arch, its outline appearing waved, and again resuming its straightness. My view of the western end was impeded by the tops of trees; nevertheless, I have a distinct impression that it terminated very near the Hyades. The other end was in full view. It just passed Arcturus, and remained quite fixed there, the only change being that a small faint streak extended from this extremity to the horizon for a few moments, but quickly faded. This fixedness of position was by no means the case with the western extremity, for the arch, during its whole visibility, moved bodily at that end from a position close to Aldebaran to one close to Bellatrix in Orion. I mean that the right or north-

ern edge was close to Aldebaran at the beginning of the phenomenon, and that the left or southern edge was close to Bellatrix at its ending. And if I remember rightly, it passed over Pollux towards the end of the time, leaving Castor uncovered; but as I have already said, the extremity close to Arcturus showed no change of position. The gleaming of the stars through the arch was very beautiful. They showed through its delicate veil of light with undiminished brightness, just as they did through the tail of Donati's comet. Its light was exceedingly white, and was for awhile considerably brighter over Leo than elsewhere.

After making these notes mentally, I walked some way down an avenue which commands a view of the northern horizon, but saw no auroral appearances there. The arch became much narrower at the end of twenty minutes; and at the end of thirty minutes it was gone. About the manner of its disappearance I cannot speak very confidently, as my thoughts at the time were dwelling on the recollection of what it had been at its brightest.

I went out repeatedly during the evening to make sure of the stars near which it should be marked on the globe, and I saw no further appearance of aurora.

The following account of the phenomenon of March 20th appeared in the *Irish Times*, the writer (who signs "J. B.") stating that his place of observation was in lat. 53° 37′ 45″, and long. 8° 46′ 7″ W., which denotes a position near Tuam:—

"I beg to inform you of a remarkable display of the Aurora Borealis which I witnessed on the night of Monday, the 20th instant. Its principal feature was a very bright and well-defined band that crossed south of the zenith from west to east, passing under the planet Mars and over Orion, under Pollux, between Leo and Coma Berenices, and under Arcturus.

"The breadth of the band was about 8°, except toward the east, where it narrowed, and ended in a point at the confines of Bootes and Serpens; and it was divided through its whole length by a black line, which reminded me of the usual dark space in the tail of a comet. It swept across the sky with a beautiful double curve that faced the north in the meridian, and bent in the opposite direction as it approached Bootes. It had a slight motion towards the south until its edge touched Betelguese, at 7h. 50m., Dublin time, after which it remained stationary until its disappearance.

"The zodiacal light was very apparent in the west, and, though its limits could not be well defined on account of the aurora and the great brilliancy of Venus, yet it could be traced nearly to a point in the Milky Way, not far from where the latter was traversed by the luminous band. The north-

western sky was spread over with a light that often broke into coruscations of white and red. There were no clouds, and a freezing gale, which had been blowing all the day from the north-east, was now subsiding. The thermometer marked 23° on the grass, and the barometer, corrected to sea level, stood at 30·25 inches."

A correspondent of the *Times*, dating "Burton-on-Trent, March 20," and giving the initials "E. B. K.," says:—

"A very fine aurora was visible here this evening. At about 7.50 p.m., the sky being then perfectly clear and free from cloud or mist, a brilliant arch of white light was formed, spanning the whole northern horizon, and extending to an altitude of about 45°. This altitude rapidly increased to about 60° in a quarter of an hour. The western extremity, which was the brightest portion of the arch, tapered to a blunt point, ending abruptly about 10° above the horizon. At 8.20 a luminous mist appeared along the northern horizon. At 8.40 the arch had quite disappeared.

"At 8.45, an arch as perfect and as brilliant as the first, formed at a much lower elevation, not more than 20°. The sky included in the arch was then quite black. I did not observe any streaks to be thrown out till 9.25, when most brilliant streamers of white light, tinged on the west side with a faint roseate hue, shot up to a considerable altitude, forming a most imposing sight. Clouds then coming over, rapidly obscured the phenomena."

LITERARY NOTICES.

A Dictionary of Science, Literature, and Art, comprising the Definitions and Derivations of the Scientific Terms in general use; together with the History and Description of nearly every branch of Human Knowledge. Edited by W. F. Brande, D.C.L., F.R.S., L. and E. of Her Majesty's Mint; and the Rev. George W. Cox, M.A., Late Scholar of Trinity College, Oxford, assisted by Gentlemen of eminent Scientific and Literary Acquirements. (Longmans.) Parts I. and II.—We are very glad to see a new and enlarged edition of *Brande's Dictionary*, which bids fair to prove a very valuable and welcome work. Most of the explanatory articles appear to us very well written, but one of the gentlemen who does the physiology is by no means up to the mark. The whole of the explanation given under the title "Animal," is more or less open to objection, and some of it decidedly wrong, as when the writer, apparently knowing nothing of amœbæ, tapeworms, or gregarina, states that "animals are *always* provided with a mouth, and an internal cavity, or canal." Again, it is not correct to say that

"animals can convert into their own substance *only* matter which has been already organized." Surely they convert water into their own substances, and every medical man who administers a preparation of iron expects to find some of it assimilated by his patient. In the endeavour to establish more differences than exist between animals and vegetables, a want of care is exhibited, and we can make nothing of such statements as that "muscular fibre reacts when stimulated by an angular puckering called contraction," while in a sensitive plant there is "only an angular plication of a contiguous part." The writer of the article "Aberration" ought not to have contented himself with saying that the "mirrors of optical instruments are generally worked into a spherical form on account of the difficulty of obtaining the parabolic curvature." Mirrors not intended for accurate performance are undoubtedly so made, but those for reflecting telescopes are made parabolic, and an amount of accuracy is attained by the best makers that deserves more acknowledgment than the statement, "that attempts have been made to adapt them to the purposes of accurate observation." We have no doubt the editors will take care that errors of the sort we have indicated are avoided in future numbers, and our remarks must not be understood to convey the impression that anything like general carelessness has been shown.

A Year on the Sea Shore. By Philip Henry Gosse, F.R.S. With Thirty-six Illustrations by the Author. Printed in colours by Leighton Brothers. (Alexander Strahan.)—This is a very elegant and interesting volume that will prove a delightful companion for sea-side visits. There may not be in its pages so much for the advanced student as in some former works by the same author, but it is an admirable popular work, and contains vivid descriptions of a great variety of marine objects, many of which can be easily found by any sojourner on our coasts, who will take the pains to follow the instructions which are given. The plates are very good, though not quite up to the mark of those in *Tenby*, or the *Devonshire Coast*, and will render it easy to recognize many species of beautiful fishes, worms, mollusks, etc., to be obtained by searching amongst rock-pools, and other modes of pleasantly spending hours by the sea. When we consider Mr. Gosse's remarkable talent as a naturalist, his admirable facilities for observation, his brilliant powers of description, his skill as a microscopist, and his capacities as a draughtsman, we are extremely sorry to find his book closing with an announcement that "it will probably be the last occasion of his coming in literary guise before the public."

A Treatise on the Construction, Proper Use, and Capabilities of Smith, Beck, and Beck's Achromatic Microscope. By Richard Beck. Printed for Smith, Beck, and Beck, 31, Cornhill. Published by John Van Voorst, Paternoster Row. 1865.—This handsome large octavo volume contains a description, illustrated by numerous woodcuts and plates, of the various kinds of microscopes manufactured by Messrs. Smith, Beck, and Beck, and of all the principal pieces of apparatus employed in microscopic research. It

also contains the finest plates we have seen of the appearance of the Podura scale under various degrees of magnification, the *Arachnoidiscus Japenicus*, some of the most beautiful *Polycystina*, the so-called glands in deal, the *Demodex folliculorum*, and certain other objects. It is not generally known that a simple split fragment of a lucifer match offers, as Mr. Beck explains, the best and readiest mode of examining the structure of deal, which is beautifully displayed under a two-thirds object-glass. One of the plates gives the appearance of Norbert's lines as shown by an one-eighth, with the third eye-piece of Messrs. Smith and Beck's series, magnifying 1300 linear. As very few microscopists have had an opportunity of seeing Mr. Norbert's wonderful ruling on glass, we may state that his lines are arranged in twenty bands, varying in closeness from a ratio of 13 to 70 in one thousandth of an inch. Mr. Beck says that "an one-eighth of 120° aperture will show them all; but when cut down to 110° it will not separate the 20th band; at 100° the 17th (63 in 001″) is the limit; at 80°, the 14th (57 in 001″); and at 60°, the 10th (45 in 001″). Thus it will be seen that these lines afford excellent illustrations of the effect of varying angles of aperture, and they are more reliable than diatom lines, because there is not the same doubt as to their real degree of proximity, which varies in different specimens of the same diatom. For testing the excellence of correction, the Podura scale is the best object for high power, and with Mr. Beck's plates and directions the merit of any objective may be readily ascertained.

On the Distribution of Rain over the British Isles during the Year 1864, as observed at about 900 Stations in Great Britain and Ireland. With illustrations. By G. J. Symons, Member of the British and Scottish Meteorological Societies. (Stanford.)—The increasing body of persons interested in meteorological inquiries will welcome this laborious compilation, and Mr. Symons deserves great credit for the zeal with which he has extended observations on the rainfall of these islands. From explanations given by Mr. Symons, it appears that up to 1864 he defrayed the entire expense incidental to the collection of rainfall statistics, and that about £100 was contributed towards the expenses of that year. We certainly hope that some arrangement may be made by which the future collection of these important facts will not be permitted to throw upon Mr. Symons a loss of money as well as a great expenditure of time.

Sea and River-side Rambles in Victoria: being a handbook for those seeking recreation during the summer months. (Geelong, Heath and Cordell; London, Kirkland & Co.)—It is very pleasant to find a cheap and prettily illustrated handbook of the popular zoology and botany of Victoria. From the skill with which Mr. Hannaford has performed his task, we cannot doubt that he will induce many of our Australian friends to devote a little of their leisure time to the pursuit of natural history, which will not only be advantageous to themselves but useful to science, as their country is rich in objects of great interest.

The Oxford, Cambridge, and Dublin Messenger of Mathematics, No. X. (Macmillan.)—As the title page informs us, this serial is "supported by junior mathematical students of the three Universities," and edited by William Allen Whitworth, and five other gentlemen well known in their respective circles. From the contents of the part before us, we have no doubt mathematical students will appreciate this publication, and find in it matter that might not be otherwise accessible.

The Canadian Naturalist and Geologist. (Montreal, Dawson; London, Baillière.)—Successive numbers which reach us of this publication show that it maintains a high character as a scientific magazine; and many of the papers on local subjects will have a permanent value that naturalists and geologists will not fail to appreciate.

A Few Words on the Choice of a Microscope. By J. J. Plumer, Esq., M.A. With illustrations. (Churchill.)—This reprint from the *Quarterly Journal of Microscopic Science* describes the principal forms of microscope in use, and the author's conclusion is that if a purchaser can afford it, he had better obtain one of the first-class instruments by one of the best makers.

Geology and History: A popular exposition of all that is known of the Earth and its Inhabitants in Prehistoric times. By Bernhard von Cotta, Professor of Geology at the Academy of Mining, Freiberg, in Saxony. (Trübner.)—Mr. R. R. Noel presents the English public with a translation of the lecture by Professor Cotta, on the evidences that man is an old inhabitant of this globe, and on kindred subjects. It is more pretentious than explanatory to call a single short essay an explanation of all that is known of the earth and its inhabitants in prehistoric times; but Professor Cotta's lecture contains a good sketch of some of the principal facts relating to these questions, and forms a convenient little book for the general reader.

Man Considered Socially and Morally. By George Sparkes, Esq., Madras Civil Service. (Longmans.)—Mr. Sparkes tells us that for many years he has been in the habit of jotting down the most noteworthy opinions on social topics which he heard or read; and the present neat little volume is a *resumé* of his collections, united together with original matter in a shape that will be acceptable to those who may have neither the knowledge nor the opportunity for the extended literary researches which the author carried on for the gratification of his own mind.

Practical Chemistry. By Stevenson M'Adam, Ph. D., F.R.S.E., F.C.S., Lecturer on Chemistry in the Medical School, Surgeons' Hall, and to the School of Arts, Edinburgh. Illustrated by woodcuts. (Chambers.)—Although we fully appreciate elaborate works, which must necessarily be expensive, we rejoice at the valuable efforts made by Messrs. Chambers, and other excellent publishers, to bring scientific information within the reach of large

classes, to whom a little money is a precious thing. This small, but very compendious volume on Practical Chemistry will, we have no doubt, assist students of medicine and arts, and advanced pupils in educational institutions, for whom it is especially intended; but it is also well adapted to the much larger class who must either go without knowledge, or be their own instructors. The title "Practical Chemistry" is scarcely explicit enough. What Dr. M'Adam has done is to compile a clear step by step exposition of qualitative analysis applied to the detection of substances most likely to occur in medicine and the arts. The arrangements appear to us very good for the double purpose of compression and easy reference. It would be a useful work for persons engaged in teaching ordinary school-classes, and we believe that before long no parent capable of paying a respectable price will tolerate any school in which physics, chemistry, and other practical sciences are entirely neglected. In all cases that admit of experiment or direct observation, the theoretical parts of science which constitute its value as a mental discipline, become much more intelligible after a requisite body of facts have been practically acquired, and it is absurd to consider that boys and girls are properly educated when they are left in total ignorance of the properties of substances and agencies upon which their existence and comfort depends.

How to Use the Barometer: a Companion to the Weather-Glass. (Bemrose and Sons.)—This little book consists of an almanack, with spaces for recording the state of the weather from day to day, prepared by explanations of barometers, thermometers, meteorological terms, etc.

London Meteorological Diagrams, showing the Daily Elements throughout the Year 1864. By C. O. F. Cator, M.A. (Sanford.)—By clever arrangement a very large amount of information is undeniably and strikingly arranged in this sheet. The daily fluctuations of the barometer for 1864, daily maximum and minimum temperatures, the Greenwich mean for each day, taken on the average of 43 years, direction of wind, weekly deaths from the Registrar-General's returns, age of moon, meridian altitude of sun, and other particulars, are made obvious on simple inspection. We hope Mr. Cator will receive adequate support in continuing this interesting work.

Homes without Hands. By the Rev. J. G. Wood. (Longmans.) Both the text and the illustrations of this interesting work keep up their character. Birds now occupy a considerable share of Mr. Wood's attention, and the portraits of the feathered builders and their abodes evince taste and skill.

ARCHÆOLOGIA.

The coast of Cheshire, extending from the mouth of the Dee to that of the Mersey, especially the part of it adjacent to the village of Hoylake, and forming part of the ancient hundred of Wirrall, has long been an object of interest to the antiquary, in consequence of the numerous antiquities, usually small objects, such as buckles, rings, brooches, etc., which have been continually picked up on the beach. These antiquities, which range from the Roman period until comparatively recent times, form the subject of a volume of considerable interest, by Dr. Hume, of Liverpool; and they now begin to assume increased interest in connection with geological questions, and that all engrossing question, the Antiquity of Man. These coasts, in fact, have no doubt undergone very great changes within no very great space of time. At a meeting of the Ethnological Society, last year, Professor Busk exhibited and described a skull, with other human bones, found, as it was said, under a layer of ancient peat, which itself lay under sandhills of very great elevation. Some little excitement was created by the discovery of these remains, which were at first believed to be those of a man of the prehistoric ages, but Professor Busk expressed the opinion that their antiquity was not great, and such proves, from an examination of the locality, to be the case. It shows how cautious we ought to be in forming conclusions of the antiquity of objects from the mere position in which they lie. As the antiquities alluded to, which are washed up by the tide or by the waves of the sea, continue to be picked up on the beach, without any apparent diminution of their numbers, they are continually furnishing new objects of interest; and we read with pleasure in the new number of that excellent periodical, the *Reliquary*, an account of the discoveries made in this neighbourhood during the last year, in an article by Mr. Ecroyd Smith, who has carefully surveyed the ground, and has given sections which explain much of the mystery in which these antiquities have been involved.

This coast, as just stated, is at present formed by great hills of loose, shifting sand, which rest upon a layer of marshy deposit of little depth, and of no very remote date. It was in or under this bed, which was mistaken by the finder for ancient peat, that the human remains were found, and they were probably those of a drowned man, whose body had been cast on the shore and hastily buried, as Mr. Ecroyd Smith thinks, within three hundred years of the present time. Next beneath this thin marshy deposit comes a much thicker bed of firm drift sand, in which are found mediæval articles, with occasionally a few remains of an earlier period at the bottom of it. This is followed by a still deeper bed of artificial arable soil, composed of bog and sand, mixed with a little marl. The objects found in this bed are also mediæval, including fragments of pottery, and bones of domestic animals, and among these was the Bos longifrons. As the antiquities found in this bed appear all to belong to the twelfth and thirteenth centuries, this discovery brings the continued existence of the Bos longifrons down

to a much later period than has hitherto been supposed. Immediately under this bed is another thinner stratum of blue marl or silt, with numerous petrified roots of Equiseta and other fresh-water plants, and among these have been found Saxon and Norman coins, and other objects belonging to those periods. This rests upon a thicker bed of forest bog soil, thickly filled with trees and shrubs, with many stumps of large forest trees, and here and there prostrate stumps. The animal remains in this bed include the deer, ox, horse, and wild boar, with land and fresh-water shells. The manufactured objects found in this bed are chiefly Roman, with a few articles, such as a coin, which are undoubtedly Saxon, and in the lower portions a few arrow-heads of flint, stone, and shell. Under this bed we come to one of about the same thickness of blue marl, containing remains of Bos Primigenius, and Megaceros Hibernicus, and Cetaceæ, but no traces of man's existence, except a few "primeval flints."

These various successive beds bear evidence to great changes which have taken place in this coast during a known period. During the Roman period, this district, now buried in sand, was covered by thick forests, which ran out far into what is now sea, and corresponded no doubt to the forests of which similar remains are found on the coast of North Wales. Opposite the Dove Point there was a considerable and elevated promontory, on which was a seaport in Roman and Saxon times, and upon Hilbre, or Helbre island, which was then much more extensive than at present, there was another Roman settlement, the site of which was occupied in the middle ages by a small monastic establishment. The objects of antiquity found during the past year on this coast, as enumerated by Mr. Ecroyd Smith, are about half a dozen Roman coins, two of which are of the Emperor Claudius Gothicus and Constantine the Great, and one of the small coins which numismatists call MINIMI, and which appear to belong to the close of the Roman period; a Roman brooch of the common harp-shape, and two pins of brooches, all in bronze, and the brooch enamelled. The mediæval objects are, a silver penny of Edward II., a pin with globular head, a needle two inches long, with the eye in a pointed head, a portion of a radiated thread-winder, part of a triangular needle, five plain and three ornamented studs of straps or belts, all of the mixed metal called in old English *latten;* a girdle-hasp of steel, and a portion of a large buckle, a flat ring of iron, and a quantity of fragments of pottery, ranging in date from the twelfth to the sixteenth century. Of later date were a shilling of James I., and several heads of clay pipes of the sixteenth and seventeenth centuries.

Very interesting discoveries have been made of late years near the village of WETTON in Staffordshire, close on the limits of Derbyshire, where numerous tumuli were formerly opened by Mr. Samuel Carrington and the late Mr. Bateman; but more recently much more extensive excavations made by the former gentleman have brought to view the floors and other remains of an extensive assemblage of residences evidently belonging to the Roman period and to people of a low class in society, possibly families connected with the Roman mining operations, as some lead ore were found. The

pavements were usually of rough limestones, or sometimes only of the earth beaten down, and they were covered with ashes, and with bones of animals, so that evidently the inhabitants, who must have lived largely upon flesh meat, threw the bones and refuse on the floor, and never troubled themselves to remove them. Pieces of broken pottery, of different degrees of fineness, were also scattered about the floors. An examination of these showed further that there had been no fixed place for the fire, but that it had been made capriciously anywhere on the floor. On one floor, which was more extensive than the others, and appeared to have belonged to a house of more lofty pretensions, were found, among other things, a small knife-blade, a pike, and a plain fibula, all of iron, and a beautiful bronze fibula, tastefully ornamented with yellow lozenges down the front. Part of a human skull was found on this floor. In others of these remains of ancient residences were found implements, or portions of implements, of various kinds, knives, a small two-pronged fork, broken querns for grinding corn, mortaria, and various other articles. In one instance the decayed remains of the four corner posts of the house were found, showing that it must have been surrounded by an area, probably of timber. Several coins have been found, but all Roman. Mr. Carrington's own account of his discoveries is printed in the *Reliquary*, and enters into very minute details, but we cannot agree with him in thinking that any of these remains belong necessarily to an earlier date than the Roman period.

Roman remains of some interest have been found at a place called Andoversford, in Gloucestershire, about fourteen miles from Gloucester, on the Avon. The chief value of the discovery, however, is that it seems to fix the site of a Roman station, called in the Itinerary of Richard of Cirencester, *Ad Antorium* (on the Avon), and lying between *Glevum* (Gloucester), and *Alauna* (Alchester), which has hitherto been a subject of considerable doubt.

Frequent discoveries of Roman remains of more than usual interest, both domestic and sepulchral, have been made along the line of the Roman road from *Venta* (Winchester), through the station of *Ad Lapidem* (site uncertain), to *Clausentum* (Bittern). One of the last of these which has occurred within the present year, is that of a Roman leaden coffin, near Bishopstoke, in Hampshire, by some men digging for gravel. The leaden coffin had been inclosed in a wooden one, which remained only in the shape of fragments of decayed wood. The coffin was made, as usual with Roman leaden coffins, out of one piece of cast lead, by cutting out the corners, and turning up the sides and ends. Inside was the skeleton of a female, with the broken fragments of apparently four vessels of pale green glass. One appeared to have had straight sides; another had presented somewhat the form of a soda-water bottle; and a third was of a more globular form. The glass was very thin, which is characteristic of a rather late date in the Roman period. The leaden coffin measured, internally, five feet six inches in length, by rather more than sixteen inches in breadth, and it was ten inches deep, so that the lady who was buried in it must have been small.

T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

ETHNOLOGICAL SOCIETY.—*April* 11.

On the African or Occidental Negro.—Dr. Crawford gave a very impartial account of the physical and mental qualities of the true Negro race, as distinguished from the other dark races, with which it is not unfrequently confounded. In the true African Negro the hair is always black and woolly, the skin black, of various shades, the eyes dark, face flat, nose depressed, jaws projecting, with thick lips and large mouth, the incisor teeth being oblique. The skin possesses a peculiar odour unknown in any other races of men.

The true Negro is of the average height of Europeans, and is the only dark race possessing the same average amount of strength. From the Negroes must be distinguished the following African races—namely, the yellow Hottentots, the Abyssinians, the Samouli, and the Galli, all of whom have long hair and well-developed features. The civilization of the Negroes cannot be compared with that of the European races; it is even far inferior to that of many other races on their own continent. Their agriculture and manufactures are of the coarsest kind; they have no literature, and have rarely ever adopted the writings of other races.

Naturally the Negroes are a home-keeping, unadventurous race, neither war, commerce, or colonization ever having tempted them voluntarily to pass their natural boundaries. In the American States, where they are under restraint, the numbers keep pace with that of the white population. In our own colonies, where they are emancipated from slavery, their numbers decrease: thus, in Jamaica, in 1833, the number of blacks emancipated was 310,000; in 1844, the Negro population had fallen to 196,000. In Hayti, where the Negroes have been their own masters for half a century, the population is stationary.

April 25.

On the Capacity of Animals for Domestication.—In a paper read before the society, "On the Domestication of Animals in the Middle Ages," a very important, but generally overlooked, distinction between the different degrees of capacity for domestication was admirably stated. Animals may be classed as those capable of complete domestication, those capable of imperfect domestication, and those incapable of domestication.

The first class is very limited in number; it includes those animals which, when once reared by man, will not willingly leave him, and, if they do so accidentally, will endeavour to return. Among these are cows, sheep, horses, camels, dogs, poultry, and pigeons.

The second group is also very limited in number, it includes many animals that breed freely in confinement, but which, if they

escape from man, will not return willingly: pheasants, partridges, deer, hawks, etc., are samples of this group.

The third class, which comprises by far the greater number of animals, are altogether incapable of domestication; many will breed in confinement, but all will escape to savage life immediately that an opportunity offers.

These three classes are well marked, and it appears doubtful whether it is possible to transfer an animal from one to the other. Thus, notwithstanding the long series of years that pheasants have been reared in a state of semi-domestication, it is impossible to render them as perfectly domesticated as the common fowl. On the other hand, wild jungle-fowl and the wild rock-dove may be reared from the nest, and will become at once perfectly domesticated in their habits, a result which it is impossible to obtain with even the most closely allied species belonging to the same genera.

It is doubtless the want of attention to there psychical differences that has rendered the efforts of the European Acclimatization Societies so abortive; in fact, it is very doubtful whether any animals exist at present in a wild state, that are capable of being perfectly domesticated so as to be useful in civilized communities.

ROYAL GEOGRAPHICAL SOCIETY.—*April* 24.

On a New Passage Across the Isthmus of Panamá.—Mr. Laurence Oliphant read a short narrative of a journey which he had made from Panamá to the Chepo, or Bayanos River, which enters the Pacific about thirty miles to the westward of the former place. Between this point and the Gulf of St. Blas, the Atlantic and the Pacific approach nearer to each other than they do in any other part, and the object of the paper was to call attention to the fact that, during the many surveys which had been undertaken with a view to discern the most practical line for a ship canal, this part had been neglected. The neck of land which divides the Atlantic from that point on the Bayanos River to which the tide of the Pacific extends, is only fifteen miles across, and however incredible it might seem, the writer had not been able to learn that this short distance had ever been crossed, much less explored by a white man. In 1837, Mr. Wheelwright attempted it, but was driven back by the Indians, and some years later Mr. Evan Hopkins started with a view of exploring this route, but was compelled to abandon it for the same reason. The object of the writer in his visit was simply a reconnaissance, the persons in whose company he made the trip having no idea of exploration, but merely visiting the little settlement of Chepo, where they had bought an estate. He was unable to reach so far as Terabla, where the influence of the Pacific tides ends, and where an expedition to cross to the Atlantic would have to start from; but he saw from Chepo a very remarkable depression in the mountain chain, about ten miles distant. He was repeatedly assured, both at Panamá and at Chepo, that the Darien Indians were in the habit of hauling their canoes on wooden slides across the Cordillera, from the Mandinga

River, and launching them in the Bayanos. Surely it was a discredit to the civilization of the nineteenth century that the Indians should be said to pass with boats from the Atlantic to the Pacific, and that we should never have had the curiosity to verify this fact or explore the only section of the Isthmus of which it could be stated with any appearance of truth.

General Mosquera (Minister of the United States of Columbia) described the efforts which the Government of his country were making to open a road across the Cordillera at the point mentioned by Mr. Oliphant. This was one out of many enterprises which were now being pushed forward with a view to increase the commerce between New Granada and Great Britain in the abundant produce of that part of Tropical America.

May 8.

On the Temperature and Currents of the Seas between England and India.—Capt. Toynbee recorded the principal observations which he had made with instruments supplied by the Board of Trade, during five voyages to India, leaving England early in July and returning about the middle of April. It was the constant recurrence of certain phenomena in the condition of the sea, in the same place and at the same time of the year, that had led him to think they might be interesting as pointing to some important conclusions regarding the Physical Geography of the sea. He found, in the Atlantic, that the specific gravity of the sea decreased on approaching the equator, a result due to the rains falling between the North-east and South-east Trades; and in the Southern Indian Ocean, in the rainy season (January and February), the whole ocean was affected by the rains then falling south of the Line. With regard to temperature, his numerous observations during the five voyages threw some light on the cold current which swept in August northward along the west coast of Africa; this he found reason to conclude curved sharply to the westward shortly after crossing the Line in about 17° W. long.: the farther east of this the colder was the water; once, between 1° 30′ to 0° 30′ N. lat., he found its temperature to descend as low as 70° (Fahr.), making the air quite cool and damp. In March this current is of a higher temperature, because it has then flowed from the south after the southern summer. Capt. Toynbee confirmed the views of Towson regarding the direction of the tracks of icebergs in the South Atlantic, and showed that the very low temperature of the sea in Table Bay, sinking to 51° in February, was due to the current setting from the ice-bearing sea, and that this was also the source of the great West African current. A few miles to the south-east of the Cape the sea greatly increases in warmth, and along the parallel of about 40°, running from the meridian of Greenwich to 50° E., there was found in each voyage a succession of *lanes* of hot and cold water, the hot as high as 67° (Fahr.), and the cold sometimes as low as 40°. Were it not for the rush of warm water down the Mozambique channel, the ice-streams travelling north-eastward would not be deflected as now, to the south-

east, but would go forward and render the passage round the Cape much more dangerous than it is. Capt. Toynbee recommended outward-bound ships to delay crossing the fortieth parallel till the longitude of 10° E. is reached, and stated that as the sea on the Agulhas Bank is always several degrees colder than that to the eastward of it, the thermometer is a good guide to tell a ship when she is coming near the land.

ROYAL INSTITUTION.—*May* 19.

The Friday evening discourse was delivered by Mr. W. Huggins, on the Chemical and Physical Constitution of the Stars and Nebulæ. The heavenly bodies occupy a position of pre-eminence, as they afford the only means of obtaining information as to objects in the universe external to the earth; but the experimentalist has to cope with the difficulty that four out of the five senses fail him in the investigation. Light is our only means of communication; but still the distances, magnitudes, and motions of many of these bodies have been determined. As with sound, we can distinguish not only the note, but the kind of material producing it, whether wood, brass, or string; so light gives indications of the substance from which it emanates. Newton first decomposed light by a prism, and showed that some rays are spread out more than others. Wollaston and Frauenhofer discovered the dark lines crossing the spectrum, and these lines reveal the constitution of the body; but this was written in cipher till 1859, when Kirchhoff announced the mode of interpreting it. Spectra are of three orders. First, a continuous coloured band, which we know must be produced by an incandescent solid or liquid, but which gives no indication of the nature of the luminous substance. Second, a spectrum, consisting of a few bright lines, which is produced by a gas or vapour. Each substance has a spectrum of its own, and that of an unknown body; being compared with the known elements, we recognize certain similar groups of lines, and find what it is. The spectra of the electric light and the magnesium were shown, to illustrate these orders. The third kind is a coloured spectrum crossed with dark lines, and these lines are produced by the absorbing effect of vapours surrounding the incandescent body, each substance in the state of vapour being opaque to the light produced by the same substance when luminous. It is, therefore, obvious that when we find what dark lines correspond with the light lines produced by luminous vapours, we are sure those substances exist around or at the surface of the light giving body. Kirchhoff explained on this principle the constitution of the sun, and the lecturer had extended this mode of observation to the moon, planets, fixed stars, and nebulæ. Our *resumé* of the researches of Mr. Huggins and Dr. Miller, contained in the Intellectual Observer for January, renders it unnecessary to repeat in detail these beautiful discoveries by which some of the elements in Aldebaran, Betelgeux, Sirius, and about fifty other stars, were determined. The lecturer dwelt upon the extraordinary absence of hydrogen from α Orionis, and speculated on the condition

of life in planets belonging to such a sun, and similarly deprived of oceans, clouds, and verdure. β Pegasi is the only other star constituted in like manner. Photographs of drawings of the stellar spectra having been shown by the electric lantern, the colours of double stars were referred to, and the spectra of Albireo (β Cygni) shown, in which the one star had numerous lines in the red, and then leaving the yellow predominant, and the other was full of lines in the red and yellow, allowing the blue to remain in the ascendant. Drawings of numerous nebulæ having been shown, Mr. Huggins then narrated his important discovery that a number of these extraordinary bodies, including the Planetary Nebulæ, the Ring and Dumb-bell Nebulæ, and the Great Nebula in Orion, had unexpectedly shown that they consisted of gaseous matter in a luminous state only, and that such gases were nitrogen, hydrogen, and an unknown substance. Those bodies which were clusters gave continuous spectra, and the nebula in Andromeda, although irresolvable in the telescope, gave the coloured band due to stars. The singular uniformity of composition, and the fact that only one line out of several nitrogen lines was visible, had given rise to much speculation. The conclusions drawn by the lecturer were—that with respect to the stars, they appear to consist, at least in part, of substances identical with those composing the earth and sun, and that the differences are those of adaptation and detail—not of plan or structure. That as the majority of elements found in the stars are those which are most connected with organic life here, it is reasonable to suppose that these stars are suns surrounded with planets like our central orb, and thus being, like it, the energizing centres of systems analogous to that of which our globe forms a part, and equally adapted to be the abode of living beings. On the other hand, it would result from the constitution of the nebulæ thus ascertained, that they are not necessarily at the enormous distance which the theory of their being clusters of stars, the light of which had blended into nebulosity, requires. The extreme simplicity of their chemical constitution also negatives the notion that they are examples of Sir W. Herschel's nebulous or primordial fluid, from which, by condensation, stars were formed, as, if so, we should find as many light lines in their spectra as there are dark ones in the fully formed stars; or if it be contended that they are in a more elementary state, and that our so-called elements are perhaps compounds, then, at least, some indications of progress would have been met with by greater complexity in a few of these bodies. On the whole, the lecturer believes that these true nebulæ are bodies possessing a structure and a purpose in relation to the universe altogether distinct and of another order from the great group of cosmical bodies to which our sun and the fixed stars belong.

COLOURS OF COR CAROLI.

On this subject we have received the following interesting letter from Mr. George Knott.

May 18*th*, 1865.

Dear Sir,—In accordance with your invitation in the May number of the Intellectual Observer, I have much pleasure in sending you the following estimate of the colours of the components of the double star, *Cor Caroli.*

1865, May 16. Instrument employed, a $7\frac{1}{3}$ inch Alvan Clark Refractor. Thornthwaite's Aplanatic, powers 102, 173.

A. Very pale yellow, almost white.
B. Pale lilac.

Using Admiral Smyth's chromatic scale the colours would be

A. Yellow^4.
B. Reddish purple^4.

I find in my Journal the following rather interesting observation of the colour of *B* of Cor Caroli *by daylight.* I quote from my Journal:—

"1862, Nov. 27, 10h. 15m. a.m. Had a fine view of the double star, Cor Caroli. The small star was in colour a little more dusky than the deep blue of the sky. I should call it deep dusky blue or lilac. $7\frac{1}{3}$ inch achromatic."

I think that it would be convenient in practice, particularly where *space* is precious (as, for instance, on a form for the entry of double star measures), to use a *large letter* to express the *disk colour* from the *scale*, and a *small letter* for the qualifying adjective. Thus, in the case of Cor Caroli, instead of writing the words, "yellow^4," "reddish-purple^4," we might write "Y^4," "rP^4." And in the same way the colour estimates of other stars might be recorded, as in the case of the following stars observed by me also on the 16th inst. :—

α Herculis A = O^3, B = bG^4.
95 Herculis A = G^4, B = O^3.
β Cygni A = Y^3, B = bG^4.

There may be cases, as you justly remark, in which a mere qualifying adjective will hardly suffice as indicative of tint; these it will not be easy to deal with. Any one with an artistic taste, and accustomed to *mix colours*, might perhaps indicate a tint by a *combination of several disk colours.* It is probable, however, that his combination would convey but a very indistinct idea of hue to the *uninitiated.*

Thornthwaite's aplanatics are very pleasant eye-pieces to use in colour estimations; unfortunately they labour under the disadvantage of a rather annoying *ghost.* It is necessary, too, to pay some little attention to the proper cleansing of the field lens, and in those I have the field is not perfect *to the edge*; there is a band of distortion which one would be glad to get rid of. In the "Monthly Notices,

R.A.S., Nov., 1862," Mr. Dawes remarks that Steinheil had for some years made an eye-piece, which was apparently identical with the "*Aplanatic* in construction."

[We have three of the Aplanatics, and have in our specimens very little fault to find with the field almost close to the edge. The "ghost" is, we believe, a reflexion inseparable from the construction. It causes a faint image of a bright object to move one way while the object appears to move in the other. By a little care the image and the ghost may be made to coincide.—Ed.]

PROGRESS OF INVENTION.

New Applications of the Syphon.—It has been found, by Mr. Galletly, that different fluids pass through the very same syphon with different velocities—an observation made, indeed, by others; and also, that the same fluid passes with different velocities through syphons of the same length, but of different bores. Thus, while a vessel of water was emptied by a given syphon in forty-nine seconds, it required eighty-three to empty it of petroleum, and eighty-five to empty it of whiskey. Nor does the result depend, in any way, on specific gravity; for while paraffin oil was emptied in two hundred and eighty-six seconds, petroleum of the very same density required three hundred and seventy-five seconds. These, and similar experiments, suggested the syphon as a convenient means of ascertaining the difference between fluids, or the different degrees of purity of the same fluid, a standard vessel and syphon being employed for the purpose.

Waterproofing by means of Paraffin.—The rendering of textile fabrics, leather, etc., waterproof, has long, and justly, been looked upon as a matter of considerable importance. Many means have, at various times, been employed for the purpose, but all, or most of them, have been found open to objection. Wax and drying oils were the substances first used, then caoutchouc, and afterwards gutta percha, both by itself and along with drying oils; recently, paraffin has been adopted, but, if used by itself, it crystallizes and separates from the fibres of the cloth, an inconvenience which is prevented by the addition of a small amount of drying oil. This mixture possesses the great advantage of rendering a fabric repellant of moisture, while at the same time it does not prevent the passage of air through it; and it affects but little, or not at all, the most delicate colours. It is particularly advantageous to leather, which it not only renders waterproof, but more durable and susceptible of a higher polish.

New Mode of Preserving Iron.—In this, which may justly be denominated the "iron age," any effective mode of preserving that metal must be considered of great importance. Almost everything

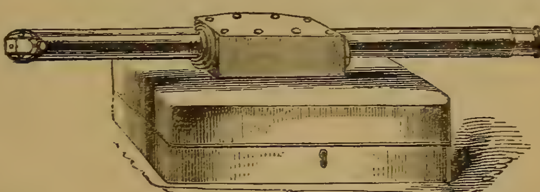
is now made of iron, and yet it is the most perishable of the ordinary metals. This circumstance becomes a source of serious anxiety when we reflect that the vast majority of our railway bridges are made of it. They cannot, as usually constructed, last more than a very few years; since, in a short time, the thin plates of which they chiefly consist, will become so corroded as to be no longer capable of supporting the weights they are required to bear. Various modes of preserving the iron have been tried, but unfortunately none of them have proved very effective; oxidation goes on under the very coating which is intended to exclude the atmosphere. There is, however, now reason to hope that ingenuity, which has vanquished so many difficulties, will conquer this also; and one step seems already to have been made towards the attainment of the desired object. It has been found that the combination of phosphorus with the surface of the iron, at a high temperature, completely preserves it; since the coating of phosphate of iron thus produced is a very stable compound, and one that is not acted upon by those agents which usually produce so mischievous an effect on iron. Should this mode of protection be found, in practice, and especially on the large scale, easy of application, economical, and effective, one of the most perishable may become one of the most lasting of metals, a circumstance that would add enormously to its value.

New Application of Chloride of Silver to Photography.—The deterioration of photographs has been the source of great disappointment or anxiety. Various means have been used for preventing it, but few of them have inspired much confidence, and it is yet uncertain if any of them will prove thoroughly effective. A recent application of chloride of silver, however, by Mr. G. Wharton Simpson, seems to exclude those conditions from which a change in photographs may be supposed to arise. He found that, if nitrate of silver is dissolved in collodion, and is changed into chloride by the addition of a few drops of a solution of chloride of sodium, the resulting chloride of silver is not precipitated, as might be expected, but remains, at least for a considerable time, suspended; so that although, by transmitted light, the collodion is perfectly transparent, by reflected light it is white like opal glass; and that, provided sufficient nitrate has been used, it gives a vigorous image on paper. It is extremely sensitive, and affords very good pictures with indifferent negatives, while even the Wothlytype requires that they should have considerable density. The collodio-chloride paper has many advantages over the albumenized. It is impossible that the latter can be of a uniform quality, since every succeeding sheet immersed in the solution of sensitive salts exhausts it, and diminishes its efficiency with regard to the next sheet. On the contrary, paper coated with the collodio-chloride is, to the very last sheet, of exactly the same strength. Perfect uniformity of effect is, therefore, easily attainable with it. But the most important circumstance connected with this preparation is the fact that, no soluble compound of silver being present, if the picture is properly fixed and washed, there is reason to believe that it will be permanent.

NOTES AND MEMORANDA.

The Dark Part of Venus' Disc.—Dr. Engelmann, of the Leipzig Observatory, speaking of successful trials made with a new 8-inch glass of Steinheil, states that on the 20th of April the dark side of Venus was very strikingly seen. It appeared of a clear greenish-grey tint.

New Spectroscopes.—The Herschel-Browning spectroscope, which has now been some months before the public, is recognized as the best instrument of its class, viz., that of direct vision spectroscopes having considerable dispersion, and obtaining the direct vision with little loss of light. It is composed of two prisms, each possessing direct vision, in consequence of the light ray experiencing two internal reflexions. As the principles involved in the construction of these instruments are of considerable interest, and can only be made clear by elaborate explanation and diagrams, Mr. Alexander Herschel has, at our request, supplied a paper on the subject, which will shortly appear, and we shall now only exhibit the form of the spectroscope devised by himself, and modified by Mr. Browning. We have taken several opportunities of looking through these spectroscopes, and have been much struck by the sharpness with which they exhibit, with a low power, a great multitude of dark lines. For quick examination of atmospheric lines, and for noting the changes that occur near the horizon, or in any particular direction, this form of spectroscope is the best yet devised, as it can be instantaneously and accurately pointed at any cloud or in any direction. Its dispersion and precision are so great as to divide the line D with a magnifying power of only 5.



In the Herschel-Browning spectroscope considerable dispersion is one of the objects sought and obtained; but, as we explained in our last number, there are occasions on which the dispersion should be comparatively small, and the instrument adapted to work with a minimum of light. Mr. Browning exhibited at the Royal Society's *soirée* an instrument of this kind, made for Mr. Gassiot. It consists of three prisms, united together by Canada balsam, to prevent loss of light by reflection at the surfaces of contact. The centre prism is of dense glass, and the two side ones of lighter glass, so adjusted as to counteract the refraction of the centre prism, and leave two-thirds of its dispersive power. We tried this instrument in various ways with much gratification. From its exquisite definition it exhibits the Frauenhofer lines in greater quantity and with more separation* than would have been expected, and with a careful management of light shows the blood absorption bands in extremely weak solutions. The solution we employed was obtained by macerating a very small morsel of raw meat in an ounce of cold water. A few drops of this solution, in about an ounce of water, gave a noticeable result, and we did not by any means arrive at the extreme limits of the power of the instrument. We must postpone a description of two other new spectroscopes exhibited by Mr. Browning at the Royal Society's *soirée;* one is the "Rigid Spectroscope" made for Mr. Gassiot, "to test whether any relationship exists between refraction and gravitation," and the other a striking optical instrument of recreation, "the Revolving Spectroscope, producing changing symmetrical figures of gorgeous colours in endless variety."

* The apparent separation depends partly on the amount of dispersion, and partly on perfection of definition. A good prism, like a good telescope, will show a division where a worse instrument with the same power would show coalescence.

Use of Coffee in Crétinism.—Dr. Chabrond states that during the last twenty years crétinism has been on the decrease in the arrondissement of Briançon, and, amongst other causes, he attributes the amelioration to the use of coffee. In a Bohemian village, in which the people were very poor, lived chiefly on potatoes, and exhibited a very low state of vitality, the medical men advised the use of coffee, and it has been found highly beneficial.

Secchi and Herschel on the "Willow Leaves" in the Sun.—The *Monthly Notices of the Astronomical Society* contain a letter from Father Secchi to the effect that he observes on the solar surface a multitude of bodies "like oblong filaments, or rather like bits of cotton wool of an elongated form." He thinks it very difficult to compare them with any terrestrial object, but considers the term "leaves" not badly chosen, except that they do not possess the regularity and uniformity of leaves. He observes likewise a great quantity of black pores, which seem to show that the photosphere is not a continuous stratum. He compares the sun's photosphere to what he once saw from Monte Cassino, when the valley beneath was full of clouds, and the sun darted his rays on an ocean of mist, except that the shadows are deeper in the sun than they were in the terrestrial clouds seen from above. He concludes that the luminous stratum of the sun is really made up of clouds, the only difference being, that while terrestrial clouds are composed of water-drops, or crystals, the sun-clouds are of some other substance. When a spot dissolves, he notices forms of *cumuli*, *cirri*, and *strati*, such as are seen in our skies. Sir J. Herschel, commenting on this letter, expresses the opinion that the floating bodies are "permanently solid matter, having that sort of fibrous or filamentous structure which fits them when juxtaposed by drifting about and jostling against one another to collect in flocks, as *flue* does in a room." Sir John does not assign any reason for regarding them as *permanent* solids. The non-luminosity of the medium they float in he ascribes to its being colourless and transparent. He adds, "colourless gases or transparent liquids give off no light from their interior. To convince yourself of this, take a dish or crucible, and melt a quantity of nitre, and bring it to a full red heat. You will see the whole surface of the nitre *uniformly* bright by the red heat of the crucible seen through it, whereas if the liquid emitted light from its *interior*, the deeper portions should appear the brightest.

New Hygrometer.—M. Babinet lately exhibited to the French Academy a new hygrometer contrived by MM. Engard and Philipon. It is made of a spiral ribbon of ivory, cut perpendicular to the axis of the tooth. It is stated to be a very sensitive instrument, and to contract and dilate in a circular way.

New Source of Theine.—Dr. Attfield, F.C.S., Director of the Laboratories of the Pharmaceutical Society, has a paper on this subject in the *Pharmaceutical Journal.* He finds theine to the extent of two per cent. in dried Kola-nuts, which form a favourite article of food and medicine in West Central Africa. Coffee, he states, contains from ·5 to 2·0 per cent. of theine, and tea from ·5 to 3·5 per cent. Dr. Attfield remarks that the presence of theine shows an analogy between the Kola-nut, and coffee, tea, Paraguay tea, and Guarana. "Infusions of one or other of these beverages are used probably by three-fourths of the human race, and each contains the same active principle—theine."

Axolotls in Paris.—These curious reptiles, belonging to the Batrachian, or frog division, and remarkable, amongst other things, for having persistent gills, have been successfully treated in the *Muséum de Histoire Naturelle* in Paris, which possesses five males and one female. The latter laid a quantity of eggs on the 19th of January last, attaching them in parcels of twenty or thirty to solid bodies in the tank. The eggs resembled those of other batrachians, and the first hatching took place from twenty-eight to thirty days after the laying. The gills were at first much simpler than in the adult. In a few days the mouth opened, there being at first no aperture, and the little creatures eagerly devoured animalcules swimming in the water.

THE KING PENGUIN.

Aptenodytes Pennantii.

THE INTELLECTUAL OBSERVER.

JULY, 1865.

THE KING PENGUIN (APTERODYTES PENNANTII).

BY W. B. TEGETMEIER.

(With a Coloured Plate.)

FEW events have occurred more interesting to European ornithologists, who have never visited the Southern Hemisphere, than the recent arrival of the King Penguin at the Zoological Gardens, Regent's Park.

From time to time various efforts have been made to bring to England specimens of different species of the extraordinary group, constituting the family *Spheniscinæ*, but these have always hitherto proved failures. For the possession of the individual whose portrait is so correctly given in the coloured plate, the Zoological Society were indebted to Commander William Fenwick, of H.M.S. Harrier, who brought the bird from the neighbourhood of the Falkland Islands.*

The family of the penguins (*Spheniscinæ*), which includes several distinct genera, comprises unquestionably the most aquatic of all birds. Flight, the usual means of progression of the class to which they belong, is entirely denied them. On land their progress is slow and comparatively awkward, but in the water their movements are rapid and easy to an extreme degree. In swimming and diving their speed surpasses even that of the majority of fishes. They sport and seek their food safely during the heaviest gales, and spring from the water in play with such rapidity, that they cannot be distinguished from leaping fish, and as they feed their beloved young on the rocky islands of the southern seas, they recal to mind the exquisite lines of Shelley, as—

* Notwithstanding the care taken of the penguin at the Zoological Gardens, it unfortunately died.

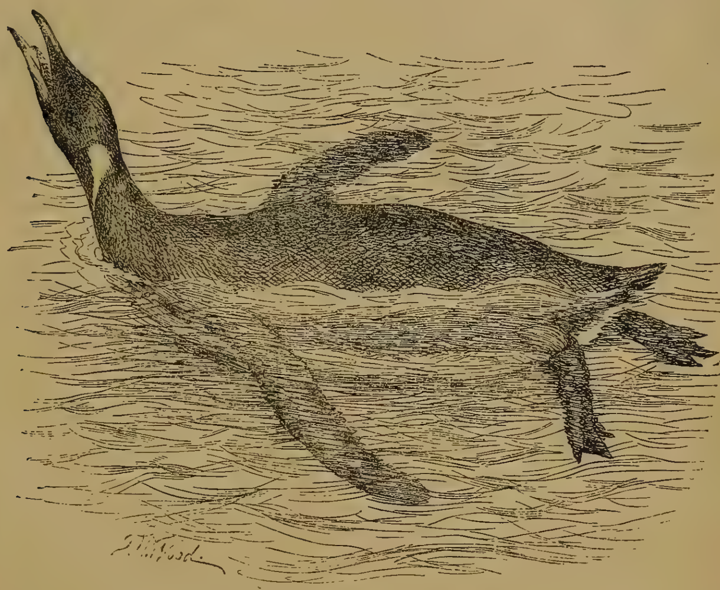
"Outspeeding the shark
And the sword-fish dark,
 Under the ocean foam;
And up through the rifts
Of the rocky cliffs,
 They pass to their Dorian home."

In the water but little is known of their movements, as the opportunities of observing them have necessarily been very limited. On land, however, their movements and mode of life are more open to investigation, and from the singularity alike of their structure and habits, they have attracted much attention from all those naturalists who have visited high latitudes in the southern seas. Thus Mr. G. Bennett describes a colony of one species of these birds as existing at Macquarie Island, in the South Pacific, and covering an extent of thirty or forty acres. Their number was immense, many thousand birds constantly passing to and from the sea. He states: "They are arranged when on shore in as compact and in as regular ranks as a regiment of soldiers. The females hatch the eggs by keeping them between their thighs, and if approached during the time of incubation, move away, carrying the eggs with them. At this time the male goes to sea and collects food for the female, which becomes very fat. After the young is hatched, both parents go to sea and bring home food for it, and it soon becomes so fat as to be scarcely able to walk, the old birds getting very thin. They sit upright on their roosting places, and walk in the erect position till they arrive at the beach, when they throw themselves on their breasts to encounter the heavy seas met with at the landing place."

Like almost all birds they are valiant in the defence of their eggs and young. The late Admiral Fitzroy, who commanded the exploring expedition in H.M.S. Beagle, speaking of the multitude of penguins in the thick rushy grass "tussac" of the shore of Noir Island, states "they were very valiant in self defence, and ran open-mouthed by dozens at any one who invaded their territory, little knowing how soon a stick would scatter them on the ground. The young were good eating, but the old were dark and tough when cooked. The manner in which they feed their young is curious and amusing. The old bird gets on a little eminence, and makes a great noise between braying and quacking, holding its head up in the air as if it were haranguing the penguinery, while the young one stands close to it, but a little lower; the old bird having continued its clatter for about a minute, puts its head down and opens its mouth widely, into which the young one thrusts its beak, and then appears to suck from the throat of its mother for a minute or two, after which the clatter is repeated, and the

young one again feeds, and this continues for about ten minutes."

Mr. C. Darwin describes very graphically the behaviour of one of these animals whose retreat to the sea was intercepted by him:—"One day, having placed myself between a penguin (*Spheniscus demersus*) and the water, I was much amused at watching its habits. It was a brave bird, and till reaching the sea it regularly fought and drove me backwards. Nothing less than heavy blows would have stopped him, every inch gained he firmly kept, standing close before me, erect and



KING PENGUIN SWIMMING.

determined. When thus opposed, he continually rolled his head from side to side in a very odd manner, as if the power of vision lay only in the anterior and basal part of the eye. This bird is commonly called the jackass penguin, from its habit while on shore of throwing its head backwards, and making a loud strange noise very like the braying of an ass. While at sea and undisturbed, its note is very deep and solemn, and is often heard in the night time. In diving, its little plumeless wings are used for fins. When at sea and fishing, it comes to the surface for the purpose of breathing with such a spring, and dives again so instantaneously, that I defy any at first sight to be sure that it is not a fish leaping for sport."

The different species have very different modes of making their nests and incubating. Of one species, the jackass penguin, breeding in the Falkland Islands, situated in 51° south latitude, Captain C. C. Abbott writes: "Thousands visit the land in October, to burrow in the soil and deposit their two white eggs in the deep hole that they have excavated." He observes that the habits of these animals are affected by the proximity of man, as at places remote from settlements the holes are comparatively shallow, but near to human habitations they are much deeper, so as to prevent the eggs being taken.

This species is described as walking upright, except when frightened and hard pressed, when it loses its balance, and falls forward, employing its wings as legs in escaping through the tussacs, as described by Mr. C. Darwin.

Another species, *Eudyptes papua*, the gentoo penguin, forms regular rookeries, or perhaps they may be more correctly termed penguineries, sometimes situated even miles from the shore, and far removed from salt water. Leading to these are regular paths, along which detachments of twenty or thirty birds may be seen marching at a time. No particular nest is formed, but the eggs laid by each bird are placed as closely together as the animals can stand.

A third species, common in the Falkland Islands, is known as the rock-hopper. It lays during the first week in November, on the cliffy slopes near the fresh-water streams. although, like the gentoo, it is constantly passing to and from the sea. The breeding-places are sometimes of as great an extent as 500 yards by 50, the eggs being placed so close together that it is impossible to walk without treading on them. Amid the multiplicity of nests and eggs, it is almost impossible to imagine how the birds can find their own nests, after having once been driven off. Yet they appear to do this without difficulty, each walking straight back to its own nest, and placing the eggs between its legs with the utmost care, so as to bring them both in contact with a bare space in the centre of the lower part of the body; the male, when not fishing, standing up alongside of the female.

Cormorants are described as breeding close to the penguins, both species associating in harmony.

Not so, however, the predaceous skua gull, that watches for an unprotected nest, and destroys the eggs or young, in the absence of the parents.

Having described the habits of these birds, as existing in a state of nature, I am desirous of saying a few words as to their extraordinary structure, and its correlation to their peculiar mode of life.

The entire family of the Spheniscinæ are characterised by their short fin-like wings, which are covered with dense scale-like feathers. The tail in all the genera is composed of rigid narrow feathers. The tarsi, usually so long and leg-like in birds, is excessively short, the feet flat and webbed, the hind toe being very small, attached to the inner toe, and directed forwards.

The family includes four genera, Spheniscus, Eudyptes, Pygoscelis, and Apterodytes. In the genus Spheniscus, to which the common jackass penguin, *S. demersus,* belongs, the upper mandible is hooked, and the lower truncated, so as to give the beak somewhat the character of that of an albatross. Eudyptes includes the crested penguin, or rock-hopper, *E. Chrysocome,* the description of whose habits has been already quoted from Captain Abbott, a species which is found in all the seas of the Southern Hemisphere, sometimes hundreds of miles away from land, M. Lesson having noticed them in south latitude 43° 8′, and west longitude 56° 56′.

In Apterodytes, the most interesting genus to us at the present time, the bill is nearly straight, slender, bent slightly at the tip, and longer than the head, both mandibles being pointed.

This genus contains two species, that were formerly confounded under one name; but they were distinguished by Gray, in his *Genera of Birds,* and named *A. Fosterii,* the emperor, and *A. Pennantii,* the king penguin.

The outward form of the king penguin is admirably given in the drawings of Mr. Wood. The erect attitude, the mode of progression, the peculiar form of the body, and the singular fin or flapper-like character of the rudimentary wings are all made evident; but there are in the internal structure of these singular birds many curious modifications which require a passing notice.

The skeleton, as may be readily imagined, is most peculiarly formed. The bones composing it are hard, dense, and compact. Unlike those of aërial voyagers, they do not contain air, but their cavities are filled with oily marrow. The air-cells which in ordinary birds surround the different viscera, and so aid in producing the extreme buoyancy required for flight, are small and rudimentary in the penguin.

The bones of the upper extremity are peculiarly adapted to the aquatic habits of the bird. The scapula or blade-bone, narrow in all birds as compared with its size in mammals, is very straight and unusually large at its posterior or lower extremity. The whole of the bones of the fore limb are thin and flat, so as to constitute a thin paddle that can be passed edgeways through the water; as it is brought forwards prepa-

ratory to making a propelling stroke. Two of the bones of the carpus or wrist are remarkably large. Of the metacarpal bones, or those corresponding to the palm of the hand in man, two only are developed, supporting respectively the middle and little finger. The thumb bone, which in most birds is found supporting the little winglet, is entirely wanting.

In the feet the tarsus or portion of the limb usually covered with scales, and generally but incorrectly termed the leg or shank, is excessively short, and is placed on the ground in walking, so that the animal moves with a plantigrade step. The muscles constituting the flesh are peculiar, being excessively firm and of a dark red colour. The pectorals—those on the breast which move the wings—are singularly arranged. In the greater number of birds, the outer muscle, which pulls down the wing and causes it to strike the air in its flight, is by far the larger, the one underneath, that serves to raise the wing, being much weaker; but in the penguin, where the wing has to be drawn forwards through so resisting a medium as water, the muscle raising the paddle or bringing it forward is greatly developed, and extends the entire length of the sternum.

The feathers are very peculiar; but little more than the mere shaft is developed, and this is so flattened, especially on the paddles, as to form a series of overlapping scales, much more closely resembling the covering of a fish than that of a bird. The feathers on the body are bent in the middle of their length, nearly at right angles, so that although the basal portion rises erect from the skin, the terminal ends overlap so as to form a close layer impervious to water. This arrangement, however, is not peculiar to the penguins, but may be found in almost all aquatic birds, the breast feathers of the common duck furnishing a good example.

The feathers of the tail are very peculiar, being stiff and spiny, so as to support the body, and form with the two legs the tripod on which the animal stands when in the erect position.

The bones of the tail, moreover, are strangely modified: in birds in general the last caudal vertebra is expanded into a share-shaped process, flattened from side to side. This is adapted to the support of the quill feathers used in flight. These are absent in the penguin, consequently the last bone of the tail is unexpanded; and as another remarkable peculiarity, the absence of the oil gland, or uropygium, may be noticed. It is strange that this gland, which is generally so very large in ducks and other water-birds, should be absent in the most aquatic of all; the explanation most probably is that the scale-like plumage of the penguin does not require oiling to

prevent the entrance of water, like the softer plumage of the duck.

As in all diving birds, the internal veins (*venæ cavæ*) of the penguin are immense in size, and serve as reservoirs for the impure venous blood, until the return of the animal to the surface enables it to be purified by breathing.

One more point respecting the structure of these singular animals, and I have done.

In almost every other bird that exists, the pupil of the eye is circular; in the penguin it is an elongated slit, a variation to which their singular mode of looking at an object, noticed by Mr. C. Darwin, is most likely due, and which has probably some direct reference to their subaqueous mode of life.

THE PIGMY OWL.

GLAUCIDIUM GNOMA, WAGLER.

Strix passerinoides, Tem.; *Strix infuscata*, Tem.; *Glaucidium Californicum*, Sclater.—The Medicine or Death Owl of the North-West American Indians.

BY J. K. LORD, F.Z.S.,

Late Naturalist to the British North American Boundary Commission.

This rare and beautiful little owl, the smallest of all the North American species, I shot for the first time on Vancouver Island. It has also been obtained, though rarely, in Oregon, Washington territory, and California.

The habits of this tiny bird appear little known; its diminutive size, shy, solitary habits, always hiding amongst the thick foliage of the oak or the pine, except when feeding, renders the task of observing it, or obtaining a specimen, at all times difficult; hence a few dried skins, from which its generic and specific characters have been determined, are the only records we possess. How the recluse lives, where he lives, or what he does, are secrets only revealed to the wanderer or naturalist, who, on the sunlit prairies, and in the gloomy forest, sees for himself how its denizens conduct themselves—in this manner the following notes were gleaned: missing pages in the history of the *Pigmy Owl*, which I here venture to supply.

Early in the spring, whilst collecting the migrants, which arrive at Vancouver Island in great numbers and variety of species—some to remain the summer through, and others only

to rest awhile, as they journey further north to their breeding grounds. Dame Fortune, fickle though she generally be, deigned for once to smile, and afforded me an opportunity I had long desired, to watch the habits of the pigmy owl. Two of these strangers selected as their home a gnarled and twisted oak (*Quercus garryana*), that grew alone on an open patch of gravelly ground near a small lake. Close by this lake was the remains of an Indian lodge, that had been once used as a fishing station, affording me a capital place of concealment, to watch the manners and customs of these—to the aborigines—potent and much-dreaded *spirits*. My camp was not far away, thus enabling me to reach my hiding-place at the first blush of morning. No sooner did the rosy light creep down the valley and spread over the plain, than the owls were up and stirring—evidently hungry from a night's fasting, for, like a well-conducted couple, they retired early to rest.

Their flight, short, quick, and jerking, similar to the movement of the sparrow-hawk, quite unlike the muffled, noiseless flap of the night-owl, as it sails along over marsh and meadow, in pursuit of mice and lizards, or any benighted rodent that has incautiously strayed too far from its place of safety. The food of this little owl is entirely insectivorous; its favourite morsel a fat grasshopper, or field cricket—not that it by any means refuses or objects to breakfast on an early riser, be it beetle or butterfly, that, like the proverbial worm, is so devoid of prudence as to permit the early bird to gather it.

When in pursuit of food, the owls perch on a small branch, near the ground, sit bolt upright in an indolent and drowsy manner, until their quick eye detects an insect moving on the plain; they then pounce suddenly upon him, hold him down with their small but powerful claws, and with their sharp curve-pointed beaks tear the captive to pieces. The hard wing-covers and thighs, if a cricket, or the wing-shields, if a beetle, are rejected, only the soft abdominal parts being eaten. Hunger satiated, they return to their tree, and, cuddling lovingly together, sit and doze away their time, protected from the blazing rays of the mid-day sun by the leafage of the sturdy oak. Breakfast disposed of, and the preparations completed for the diurnal siesta, I used to abandon my post and, like the owls, eat, and indulge in a refreshing sleep under some shady covert. Thus rested, the remainder of the day was passed in collecting, or preserving what I had already obtained, until the murmurs of the forest gradually dying away, the softened light, hovering round each peak and crag, warned me of the sun's departure. Again betaking myself to my lair, I awaited the owls' reappearance.

As near as possible to the mergence of twilight into night —what the Scotch call the *gloaming*, and in our country is known as *cock-light*—when the woodcock skims through the grove, and the blackbird chink-chinks his vesper hymn—exactly at this time the owls invariably came out, and, as if for the purpose of stretching their limbs rather than feeding, took erratic flights round the tree, and up and down the plain, chasing one another and performing all kinds of inexplicable manœuvres. Occasionally they settled on the ground, but never remained long. I do not think they ever capture an insect whilst on the wing, and a very small quantity of food appears to satisfy their wants. As it became dark, having supplied their evening necessities, again they returned to their dormitory, and, as I imagine, slept away the night.

In their habits they appear to have nothing in common with the typical owls (*Striginæ*), and approximate, though slightly, to the day owls (*Nycteininæ*). Cassin, in his *Birds of California*, calls this owl *Glaucidium infuscatum*, regarding it as the *Strix infuscata* of Temminck. Dr. Sclater, however, proposes to call it *Glaucidium Californicum* (*Proceedings Zoological Society*, 1857, page 4). There can be no doubt that the two names, *Strix infuscata* and *Strix passerinoides*, were used by Temminck to designate the same species, which is strictly from South America, and quite distinct from our little friend, though closely allied. The name *Gl. gnoma*, used by Wagler, I adopt as having precedence.

Its specific characters need not be given here, being readily obtainable by referring to any of the list of works quoted in the synonymes. I may mention, however, that the grand and marked specific differences, as distinguishing this from the South American species, are that in *Gl. gnoma* the toes are naked, the colour generally lighter, and the size somewhat less. Total length of male, 7 inches; wings 3½, tail 3. The sexes are very nearly alike, but the female rather the larger, and more thickly spotted with white.

Early in May, two small white eggs were laid—round, and very rough on the surface—a large knot-hole in the branch of the oak being selected as the nesting-place; not a particle of anything was used as lining, the eggs being deposited on the bare wood. The length of time occupied in incubation I regret inability to state, having to shift my camp some distance away soon after the female commenced sitting. When next I visited the tree, both young and old were gone, much to my disgust and annoyance. By the scattered feathers that lay ominously beneath the tree, I imagine a prowling martin, or fisher, had played havoc with my pet family, and devoured, perhaps, both parents and children.

The Indians, without exception, hold this little owl in terrible dread; to see one in the day, or to hear its feeble cry, not unlike a stifled scream, is a fatal omen to *brave* or *squaw*—the hearer or a near relative is sure to die ere the end of the moon. To kill one is an unpardonable heresy; I nearly got into very serious trouble for shooting a specimen of this little owl. An Indian deputation, headed by their chief, waited on me, protested against my risking theirs and my own inevitable destruction. All reasoning was futile, and there was nothing for it but to procure all mystic birds and mammals by stealth.

It is a curious fact that owls, in every part of the world, have always been deemed birds of ill omen. The crumbling ruins of an ancient monastery, the old tower in the ivy-clad castle, and the ghost's chamber in a haunted house, are invariably associated with owls and goblins grim.

Pliny, in his Natural History, when speaking of birds of evil, says: "The owl is a dismal bird, and very much dreaded in public auguries; inhabits deserts, that are not only desolate, but dreary and inaccessible; it is a monster of night, nor does it possess any voice, but a groan."

Virgil alludes to it as foreboding the death of Dido:—

> "Solaque culminibus ferali carmine bubo
> Sæpe queri et longas in fletum ducere voces."

Shakspeare, too, saddles this poor bird with the guilt of ominous predictions.

Casca, in alluding to the events preceding Cæsar's death, says:—

> "And yesterday the bird of night did sit,
> Even at noonday, upon the market-place,
> Hooting and shrieking."

In Egypt, in bygone years, if the Pacha presented a gentleman with a drawing, or any representation of an owl, it was meant as a polite hint to the recipient of the gift, if he did not dispose of his own life, the powers supreme would save him the trouble. More modern poets rarely scandalise or malign the owl's character: as knowledge of the physical sciences has become diffused, so the mists of superstition have vanished, and modern writers, even in poetic composition, truthfully allude to its habits.

Coleridge, in *Christabel*:—

> "'Tis the middle of the night by the castle clock,
> And the owls have awakened the crowing cock."

Again Longfellow, in *Hyperion*, speaks of the owl "as a monk, that chaunts midnight mass, in the great temple of nature."

With every Indian tribe I have ever met with, either east or west of the Rocky Mountains, the owls, whether large or small, are always held sacred, their feathers being worn as charms by the medicine men, or conjurors, of the tribes. It is perhaps fortunate for the owls they are so dreaded. There are many Indian traditions I could relate, where terrible calamities have invariably followed the warnings of the pigmy owl, but space forbids.

Why such an exquisite type of Creative Wisdom—beautiful in plumage, retiring in habit, harmless, and gentle—should inspire terror and aversion, are mysteries I must leave to wiser heads than mine to solve.

SOUNDS WE CANNOT HEAR.

BY SAMUEL DREW, M.D.

Most persons, if asked whether insects possessed voice, would either at once say that they did not, or would consider the humming, or buzzing, of the various winged insects as vocal, which would be as erroneous as to confound the whir made by a covey of partridges in rising, with their call to one another after being scattered.

I, however, think that most probably the greater number of insects have voices, and that we have certainly no proof to the contrary. I do not imagine that insects possess any mode of audible communication of a very complex character, still less that they have anything like articulate speech, which their anatomy almost forbids; yet that animals, which unmistakeably do communicate with one another, and some, if not all, of which have auditory organs, should do so by determinate and intelligible sounds is certainly likely. Of the fact that they do communicate intelligence to one another no one who has ever carefully watched an ant-hill, or bee-hive, can entertain a doubt; indeed it is barely possible for the complicated arrangements of such communities to be carried on otherwise.

True we can hear no voices, for the ceaseless hum of the bees can no more be considered vocal than the tramp of a regiment of soldiers could be. Is, however, our hearing no such sound any proof that no such sound is given out? I think not.

Some years ago, when a student at the University of Edinburgh, and attending the lectures of Professor Donaldson,

I witnessed the experiment of sounding a set of small organ pipes of extreme acuteness of tone. The Professor slowly and regularly opened the air-valve of one pipe after another, beginning with the gravest, the sound of which we all heard, not only distinctly but disagreeably in its shrillness. "What a *squeal* it is!" whispered a fellow-student to me. "Ah! now it's quiet, that's a blessing," said he, as a yet more acute pipe was sounded. "Quiet!" I replied, "why, it's twice as bad." "I can believe my own ears, I imagine," was the rejoinder, "and I *know* the *squealing* has ceased." After two or three other pipes of constantly increasing acuteness had been sounded, I whispered to him rather loudly, supposing the experiment to be concluded, "Now, it is really stopped." "Bosh!" muttered a Scotch lad, just by, "If ye canna hear yon skreigh your ears are no that good."

To the utter amazement of all of us, we found that we could not at all judge of one another's powers of hearing for shrill sounds. Several persons were unable to hear notes which to me were perfectly clear and distinct; while what appeared to me complete silence, was to others broken by an ear-piercing shriek.

What appeared most singular was that the power of hearing more or fewer of these acute notes bore no relation to ability to catch slight sounds, or to the loudness of the note sounded.* It was not a matter of more or less distinctness of sound, but absolutely of sound or no sound. A person standing close to the instrument when a note too acute for his hearing capacity was given forth, could no more hear it than if he had been ten miles away, although it might seem to his neighbours but little shriller than the note immediately preceding, which he had heard as well as they could do; yet to him this was no sound at all.

Before the smallest pipe of the tiny organ had been reached, all present had ceased to hear the sounds produced, and we knew, merely from seeing the action of the bellows, or feeling the rush of air through the little tube, that a note was being sounded, although to us totally inaudible.

From various experiments with the "Siren," it has been shown that the human ear can, under favourable circumstances *of intensity*, distinguish as continuous sounds vibrations ranging from fourteen to sixteen in the second of time up to

* The *pitch* of a sound depends upon the number of vibrations in a given time. Its *intensity* depends on the amplitude of the oscillation. Loudness, or intensity, when carried to extremes, was found by Savart to have a material influence in enabling persons to hear sounds to which they were deaf under ordinary circumstances. The statement in the text is true within the usual limits of intensity.—Ed.

quite forty-eight thousand vibrations in the same time.* As there is some reason to suppose that those persons who can best distinguish very acute, are least able to hear very grave notes, we may probably assume that a range of about twelve octaves, as expressed in musical notation, includes the hearing capacity of human ears; to all vibrations of greater or less rapidity, such ears are absolutely deaf. To produce this range of sound on an organ would require pipes varying in length from 140 feet to about the third of an inch.

No reason whatever can be assigned why vibrations not included in such a scale should not, though quite inaudible to us, be distinguished as sounds by ears adapted for the purpose, and whose range of hearing, though perhaps not more extensive than our own, embraces a different series of notes. This is rendered more probable by the fact that the ordinary voices of many small animals do but just come within the range of the human ear.

To many persons the voice of the common shrew-mouse is inaudible; some cannot hear the sound of the cricket; and a few are deaf to the chirp of the house-sparrow. Very few persons are conscious of the scream of the common bat. Though well enough acquainted with that animal, I can hear no sound uttered by it. I have *seen* a bat scream when I have held it in my hand—that is, I judged from its struggles, and the action of the jaws and tongue that it was shrieking—but I could hear no sound whatever. Yet a friend, who hears more acute notes than I can, tells me that bats are very noisy little creatures.

The average tone of the human voice is not far from holding the middle place in the range of sound audible to the human ear—being about six octaves above the lowest, and six octaves below the most acute sounds distinguishable. Should the range of hearing of the bat be as extensive as our own, and, as is likely, hold about the same relative position with regard to its voice as ours does to the human voice, it would follow that sounds would be audible to the bat which were six octaves higher in tone than the most acute audible to us. Such sounds would require two and half millions of vibrations in the second to produce them.

The voice of the bat is probably the shrillest sound audible to human ears, consequently all animals whose voices are still more acute are, as far as our senses are concerned, completely mute. It does not, however, at all follow that their muteness

* M. Despretz gives thirty-two vibrations in a second as the limit of deep sounds; and 73,700 for acute sounds.—See *Ganot's Physics*, by Atkinson. Savart gives seven to eight vibrations in the second as the lowest limit of audibility when the sound is *very* loud.—Vide *Lardner's Handbook*, "Acoustics."

is absolute. That we cannot hear them is no evidence whatever that they cannot hear one another. As a general rule, the more minute animals have the more acute voices—as from the laws of acoustics might be expected—and though there are exceptions, as in the case of the frog; yet the acuteness of voice, and probably the range of hearing, usually bear relation to the size of the animal. It is therefore almost certain, judging from the size alone of insects, that we should be unable to hear any voices which they may possess, except perhaps in case of a few of the larger of them, as the death's head moth, the cicada, the grasshopper, and the cricket.

If it be once admitted that insects and other minute animals may, and probably do, utter or make determinate sounds or voices, which we cannot perceive, we may readily imagine them to have, like birds, sounds expressive of alarm, or of encouragement, of want, or affection, of pleasure, or distress, and to be well enough able to communicate with one another. An ant-hill or a bee-hive may be to the inhabitants as noisy as a rookery appears to us; the sound of a spider may be to a fly as terrific as the roar of a lion is to an antelope; while the bat may distinguish the voice of the moths on which it preys, as readily as the wolf hears the bleating of the sheep.

A singular converse proposition is also probable, namely, that insects which can very well hear one another, do not hear us at all; that to the house-fly, or cricket, men, women, and children may appear utterly dumb. Certainly many insects are quite unaffected by the human voice, and, at least, appear insensible to any sound from it. Even the exquisitely-developed ears of the bat may be unable to hear all the notes of human voices, just as the human ear often cannot hear the bat's voice.

It is stated by Scoresby and other arctic voyagers and whale hunters, that whales have some mysterious mode of converse with one another at a distance of some miles, so that an alarm of danger is rapidly communicated, and this without any sound audible to human beings being used. Some entirely unknown mode of signaling through the medium of water has been imagined to explain the fact, but it is more likely that the whale simply bellows in a graver tone than ordinary—a tone below the auditory range of the human ear, and therefore not to be heard by it, although quite within the auditory range of the whale itself. It will, of course, be understood that by voice I merely mean any voluntary and determinate sound given forth as a means of communication, whether the vocal organs be internal, as in the higher animals; or external, as they probably are in the lower.

THE GENUS ARAUCARIA.

BY JOHN R. JACKSON,

Curator, Museum, Royal Gardens, Kew.

(*With a Tinted Plate.*)

In the year 1774, the good ship "Resolution," commanded by the great circumnavigator Captain Cook, was calmly sailing along through those glorious southern seas, when the cry of "Land a-head" echoed through the vessel. All eyes were directed towards the point indicated. The faint outline of an unknown shore was visible. Gradually they neared the coast. The pleasure of those upon the deck was equalled by their surprise as by degrees the scene became more visible. They saw what appeared to them to be tall pillars, or spires, or the masts of a thousand ships, towering high over all else around them. On they sped without being able to determine what this unusual and unexpected sight could mean, till upon nearing Cape Coronation a few days after, the same objects presented themselves to view. What could they be? Could they be nearing a land where civilization held sway? or could these be magnificent columns of basaltic formation? This latter was the general opinion of the naturalists on board. Speculation was rife, expectation was on tip-toe. The enlightened Commander maintained from the first that they were trees. The telescope was kept pointed towards them, and at last it became evident that these strange pillars were, in fact, trees, but trees of a new and wonderful species. A landing was proposed, all hands being determined not to leave the place till they were satisfied as to what kind of trees they were. Captain Cook with the botanists on board now first set foot upon the island. The hearts of the enthusiastic company bounded within them at the sight, as they for the first time made the acquaintance of a goodly number of *Araucaria columnaris*. Nor was this discovery interesting alone to the botanists, here were trees the trunks of which on this little isle were from sixty to seventy feet high admirably adapted for ships' spars. Captain Cook says:—"If I except New Zealand, I at this time knew of no island in the South Pacific Ocean where a ship could supply herself with a mast or a yard, were she ever so much distressed for want of one. My carpenter, who was a mast-maker as well as shipwright, was of opinion that these trees would make exceedingly good masts. The wood is white, close grained, tough and light. Turpentine had exuded from most of the trunks, and the sun had inspissated it into a resin which was

found sticking to them and lying about the roots. These trees shoot out their branches like all other pines, with this difference, that the branches of these are much smaller and shorter, so that the knots become nothing when the tree is wrought for use. I took notice that the largest of them had the smallest and shortest branches, and were crowned, as it were, at the top by a spreading branch like a bush. This was what led some on board into the extravagant notion of their being basalts, indeed, no one could think of finding such trees here." This island was afterwards named by Captain Cook the Isle of Pines. We do not know whether at the time we write the particular tree that first attracted Captain Cook's attention ninety years since is still standing, but in 1850 it was reported to be "in a flourishing condition," and was said to exactly resemble "a well-proportioned factory chimney of great height." From the peculiarity of the foliage and general habit of Araucarias, and more especially of *A. columnaris*, it is certainly a matter of no wonder that all on board the "Resolution" were surprised and astonished upon first beholding so novel and beautiful a scene. There is, perhaps, no one family of plants more interesting than that to which the Araucarias belong (the *Coniferæ*), and it is certain of all the timber trees none have produced so much interest among botanists as the Araucarias. And there are many reasons for this, for if we except the Mammoth tree of California, the Araucarias take a position among the largest and most majestic forest trees.

To Captain Cook and his fellow-travellers, then, are we indebted for the first accurate general account of *A. columnaris*, though it had been previously mentioned by several authors, but under other names.

The Araucarias, which take their rank as the noblest of all that noble family of trees, the Conifers, are now confined to the Southern hemisphere; but there is evidence that would lead us to suppose that at one time they held a footing even in our own island. Geologists, and notably poor Hugh Miller, speak with confidence of having found fossil Araucaria stems. The microscopic structure of the wood corresponds very closely with that of the recent Araucarias. The remains of one found in the Lias of Dorsetshire have been figured and described under the name of *A. primæva*. There are some seven or eight species of the genus now known to botanists, and these are natives of Brazil, Chili, New Caledonia, Norfolk Island, Australia, etc. Some of them have been only recently introduced to our gardens, others have been cultivated for many years. A few particulars concerning them may not be without interest to the readers of this magazine. The name of the genus is derived from that of a tribe of natives called Arau-

ARAUCARIA.

canians (the word signifying freedom), who inhabit the district where *A. imbricata* abounds.

If *A. columnaris* holds good as a species, decidedly the most similar to it is *A. excelsa;* indeed, the difference seems to be so slight that many authors have united them under one specific name (*A. excelsa*). In general habit and appearance they so much resemble each other that to a casual observer not the slightest difference could be detected, without it is in the manner of branching, *A. excelsa* throwing out its branches nearly horizontally and in regular whorls, while those of *A. columnaris* are slightly inclined upwards, but this may not be the case in old plants. Loudon considers them synonymous, and says, "The *A. excelsa* is a native of New Caledonia, in Queen Charlotte's Foreland, and on a small neighbouring island, which is a mere sandbank, only three-quarters of a mile in circuit." After being discovered by Captain Cook, as mentioned above, on the Isle of Pines, it was brought home by Brown and Flinders, who found it growing abundantly on the east coast of New Holland, and the tree was introduced into this country about 1793. Of all the Araucarias the *A. excelsa* is the most beautiful and graceful in habit. Its naked, tapering trunk, with uniform branches clothed with rich green foliage, makes it a very handsome object. The leaves are not more than three-quarters of an inch long, awl-shaped, and curved upwards. The plant is not hardy, but grows well in a greenhouse, where it is fully protected from the frost. There are several fine specimens of this beautiful tree in the temperate house of the Royal Gardens, Kew, some of them over twenty feet high. These trees would have been much taller, but want of accommodation made it necessary to cut them down repeatedly. The wood of *Araucaria excelsa* is white, as indeed are most of the Coniferous woods; the upper part of the trunk is knotty, while the lower part is invariably unsound in old trees. It is, however, much used by the natives in house-building and similar work. It forms a large tree, averaging from 180 to 230 feet high. In the Sydney Botanic Garden there are some remarkably fine specimens of the Norfolk Island pine; in beauty and symmetry they are said to have no equal; their perpendicular trunks, the regularity of their branching, and being covered with the most beautiful dense foliage, give them a drooping feathery appearance. Their age is computed to be about fifty or sixty years. The largest of these trees has attained a height of seventy-six feet, and a circumference near the base of twelve feet. This tree has occasionally born fruit, the first time in 1839. Dr. Bennett, in his *Gatherings of a Naturalist in Australasia,* tells us that the first instance of perfect seeds having been pro-

duced in that colony was in 1857, when the trees at Ash Island, Hunter's River, bore female cones. The seeds, upon ripening, scattered themselves, taking root and producing young plants spontaneously, thus naturalizing the plant as it were.

A. excelsa is of all the species the most majestic, and the places of its growth perhaps the most picturesque. It loves the mountain side, the overhanging precipice, the storm-torn rocks; among these it firmly anchors itself with its twisting roots. These roots descend many feet into the ground and penetrate into every lateral crevice. They form wood of some thickness and of great density, of a deep red colour, from which the inhabitants make small articles of utility or ornament, such as candlesticks and the like. From the tremendous storms with which Norfolk Island is occasionally visited, the Araucarias suffer considerably, but chiefly in their uppermost branches; in the valleys where they are more sheltered, therefore, the best formed and most symmetrical trees are to be found. They do not grow in very dense forests, other and smaller trees coming in and filling up the spaces between them, thus tending to give the forests a very ornamental appearance. The wood is free from any resin, but a sort of white milky juice exudes from the bark: this has been tried for various purposes as a substitute for pitch, but found to be useless. A former governor (Governor King) of Norfolk Island was so partial to this tree that he adopted it as his family crest. Another species of this group, and nearly allied to *A. excelsa*, is *A. Cunninghami.* This, which is called the Moreton Bay pine, was named by Aiton in honour of the indefatigable botanist and explorer Allan Cunningham. It is found on the shores of Moreton Bay, in lat. 14° to 29° south, and on the alluvial banks of the Brisbane River, lat. 27° to 30° south. It grows, however, in the greatest profusion in the brush forests, on the Richmond River. The trees seem to thrive best near the coast, attaining in such a situation their greatest height, often from 100 to 130 feet, but gradually diminishing in height the farther the trees are inland. It would appear from this that the sea air has a great effect upon it. Other large trees of different genera are found growing amongst the Araucarias in dense woods. The Moreton Bay pine was discovered in 1770, by Sir Joseph Banks and Dr. Solander, and the first living plant did not arrive at Kew till 1824.

From the time of the discovery of *A. columnaris* in 1774 up to 1824, the two trees were considered to be the same species, but in the latter year Mr. Allan Cunningham revisited Moreton Bay in company with Mr. Oxley, and, after a careful examination, came to the conclusion that *A. Cunninghami* "was a very distinct species, not simply in its habit of growth,

which is very remarkable, but in the character of its leaves." The branches are much more drooping than those of *A. excelsa,* and very lax as compared with that species. On the young twigs the leaves are very minute, gradually developing themselves till they attain maturity, when they become slightly imbricated. The branches are given off in whorls of six or eight, in the young plants slightly bent upwards, but in those of greater age bending down in a very graceful manner. It forms a very straight trunk, frequently rising to a height of eighty feet before any branches are given off. The diameter of the trunk averages from four to five feet, the cones are ovate, from three to four inches long, and nearly as broad. The scales are very closely set together, wedge-shaped, of a leathery texture, each ending in a sharp recurved spine, about a third the length of the scale. The seeds are small and flattened, in form resembling the scale itself. The whole cone is of a deep rich brown colour. Allan Cunningham says that this plant bears young cones in the month of September. It has never fruited in this country. The wood in appearance and colour much resembles some of the lighter kinds of deal. It is of a very uniform grain, and works well. Some specimens are very beautiful, on account of small knots interspersed throughout, giving it somewhat the appearance of bird's-eye maple, though being of a lighter colour it has a more delicate appearance. It is chiefly used in the colony for house carpentry and many kinds of furniture. For the masts of vessels it is peculiarly adapted when green, as spars can be obtained in any quantity, from eighty to a hundred feet in length; but it is said in drying, these masts cannot be depended on, as there is little lateral cohesion between the fibres, and being entirely devoid of resin, there is nothing to strengthen them. The timber procured from the inland or mountain brushes is considered superior to that grown near the coast; from some trees as much as ten thousand feet of saleable timber can be obtained. From Sydney, and other parts, large quantities are imported, giving employment to a large number of sawyers, who receive pay at the rate of £2 10*s.* per thousand feet. In Queensland, also, the timber is an article of great commercial importance. Though there is no actual resin deposited in these trees, there is an abundance of a clear, white, transparent substance, which exudes from the trunks and adheres to them, hanging in the form of icicles. Some fine specimens of the wood of this tree were exhibited in the International Exhibition of 1862, in both the Sydney and Queensland collections. These are now to be seen amongst the magnificent collection of colonial and foreign woods in the Royal Gardens, Kew.

The *Araucaria imbricata,* Pav., or Chili pine, is, perhaps,

the best known of all the species, having of late years been so largely planted in this country. It was known to the Spanish settlers nearly a century back. In 1780 Don Francisco Dendariarena was commissioned by these settlers to examine the Araucarias, and report upon their suitability as timber for ship-building. The result was that the wood of *A. imbricata* was considered good, and at once applied to the repairing of the vessels of the squadron then lying in the port of Talcaguano. In a work published by the Abbate Molina, two years later (1782), the tree is described as *Pinus Araucaria.* In the same year the botanist Pavon was sent by the Spanish Government in search of this tree; having secured the flowers and fruit (the most necessary parts for determination), he had no hesitation in making it a distinct species of Araucaria (*A. imbricata*). The plant had, however, been gathered by Pavon in a previous expedition to Chili, and transmitted by him to France, where falling into the hands of Lamarck and Jussieu, the former authority named it *Dombeya Chilensis,* but through inaccuracies in the description of its botanical characters, this name fell to the ground, and Pavon's subsequent name was generally used. The tree was not known in Europe in a living state till Archibald Menzies, accompanying Captain Vancouver, secured some fresh seeds.

Having been invited to dine at the house of one of the officials, at Valparaiso, he begged a few of the seeds of this tree, which formed part of the dessert. These were planted, and carefully attended to by him on board ship; thus young plants were brought home, and were presented by Menzies to Sir J. Banks, who reared one in the garden adjoining his house at Spring Grove, and the remainder were presented to the Royal Gardens, Kew. One of these trees is now among the finest in Europe, and stands our winter climate well. Previous to 1806 it was kept in a greenhouse, but after being planted out it was carefully covered, to protect it from frost. This precaution has now been discontinued for many years, and found to be quite unnecessary, as the abundance of these trees in almost every well-kept garden testify. Plants can now be obtained for a few shillings which about twenty years since could only be had for as many pounds. The best description of the Chilian Araucaria forests is from Pœppig's travels in the Peruvian Andes. He says: "The Araucaria—a tree that affords the Indians of the Patagonian Andes a great part of their food—will not grow on the lowlands, and it also preserves an accurately defined boundary with respect to its northern limits. When transplanted into many parts of the province of Concepcion, it exhibits a sickly, deteriorated appearance, and vegetates so reluctantly that from many fresh seeds which

were sown in Talcahuano, only two sprung up, which shortly afterwards died. An Alpine atmosphere and a severer climate than can be expected in the lower tracts of the country, and above all a stony soil, seem to be indispensable for its growth. In the immediate neighbourhood of Antuco not a single tree of Araucaria can be seen, and it requires a fatiguing excursion to gratify the naturalist's desire to behold a wood of these truly regal trees." The writer then goes on to say: "Towards the evening we had ascended the moderately high ridges that form the background of the valley," which runs between Antuco and the fort of Trun Leuvu, "and the dense crown that was seen above these, from afar, had indicated our near approach to the desired aim, and added new vigour to our exertions. When we arrived at the first Araucarias, the sun had just set, still some time remained for their examination. What first struck our attention were the thick roots of these trees, which lie spread over the stony, and nearly naked soil, like gigantic serpents, two or three feet in thickness; they are clothed with a rough bark, similar to that which invests the lofty pillar-like trunks, of from fifty to one hundred feet in height. The crown of foliage occupies only about the upper quarter of the stem, and resembles a large depressed cone. The lower branches, eight or twelve in number, form a circle round the trunk; they diminish till they are but four or six in a ring, and are of most regular formation, all spreading out horizontally, and bending upwards only at their tips; they are thickly invested with leaves, that cover them like scales, and are sharp-pointed, above an inch broad, and of such a hard and woody texture that it requires a sharp knife to sever them from the parent branch. The general aspect of the Araucaria is most striking and peculiar, though it undeniably bears a distant family likeness to the pines of our country; its fruits, placed at the ends of the boughs, are of a regularly globular form, as large as a man's head, and consist of beautifully imbricated scales, that cover the seeds, which are the most important part of this truly noble tree. The Araucaria is the palm of those Indians who inhabit the Chilian Andes, from lat. 37° to 48°, yielding to these nomade nations a vegetable sustenance that is found in the greater plenty the more they recede from the whites, and the more difficult they find it to obtain corn by commerce.

"Such is the extent of the Araucaria forests and the amazing quantity of nutritious seeds that each full-grown tree produces, that the Indians are ever secure from want, and even the discord that prevails frequently among the different hordes does not prevent the quiet collection of this kind of harvest. A single fruit (*cabeza*, 'a head') contains between 200 and 300 kernels, and there are frequently twenty or thirty fruits

on one stem; and as even a hearty eater among the Indians, except he should be wholly deprived of every other kind of sustenance, cannot consume more than 200 nuts in a day, it is easily seen that eighteen Araucarias will maintain a single person for a whole year. The kernel, which is the shape of an almond, but double the size, is surrounded with a coriaceous membrane that is easily removed. Though relishing when prepared, it is not easily digestible, and containing but a small quantity of oil, is apt to cause disorders in the stomach with those who are not accustomed to this diet. When the scarcely matured seeds are dried in the sun, a sugary substance exudes, which appears to reside chiefly in the embryo. The Indians eat them either fresh, boiled, or roasted, and the latter mode of cooking gives them a flavour something like a chesnut. For winter's use they are dried, after being boiled, and the women prepare a kind of flour and pastry from them.

"The collecting these fruits would be attended with great labour if it were always necessary to climb the gigantic trunks; but as soon as the kernels are ripe, towards the end of March, the cones drop off of themselves, and shedding their contents on the ground, scatter liberally a boon which nothing but the little parrot and a species of cherry-finch divide with the Indians. In the vast forests, of a day's journey in extent, that are formed by these trees in the districts of Pehuenches and Huilliches, the fruits lie in such plenty on the ground, that but a very small part of them can be consumed. In former times a great quantity came to Concepcion and Valdivia by trading with the Indians, and thence they found their way to Valparaiso and Lima; but now they are seldom seen anywhere near the coast, or they are too old to be palatable. The reason why all the seeds of Araucaria that hitherto were sent to Europe did not vegetate, is because the collectors did not procure them from the Indian country, but bought them in the market at Valparaiso, where they are offered for sale boiled and dried. My excursion to Quillay-Leuvu obtained for me fresh seeds of the Araucaria, which reached Germany in October, 1829, being seven months after they were ripe, and being sowed immediately, the period was just that of the Chilian spring. Of some hundreds, about thirty came up; but ignorance of the true climate, which led to the error of placing the young plants in a hothouse, killed the greater part during the first year. To my great satisfaction, however, about six individual plants have been preserved in different places, and they are to the best of my belief the only ones in Europe. The wood of the Araucaria is red where it has been affected by the forest fires, but otherwise it is white, and towards the centre of the stem bright yellow. It yields to none in

hardness and solidity, and might prove valuable for many uses if the places of the growth of the tree were less inaccessible. For ship-building it would be useful, but is much too heavy for masts. If a branch be scratched, or the scales of an unripe fruit be broken, a thick milky juice immediately exudes, that soon changes to a yellowish resin, of which the smell is agreeable, and which is considered by the Chilians as possessing such medicinal virtues that it cures the most violent rheumatic headaches when applied to the spot where the pain is felt."

"The Araucaria forest of Antuco is the most northerly that is known in Chili, so that the boundary of this king of of all the extra-tropical American trees may be estimated at 36° south lat. The extreme southern limit is not so clearly ascertained, which is not surprising when we consider how little comparatively is known of Western Patagonia; it seems probable, however, that it does not stretch far beyond lat. 46°. Between Antuco and Valdivia this tree only grows among the Andes, and, as the Indians assert, solely on their western declivities, and nowhere lower than from 1500 to 2000 feet below the snow line, up to which they frequently reach. Further to the south the Araucaria appears at a lower elevation, and in the country of the Cuncos, and about Osorno, is said to occur on mountains of a very moderate altitude near the sea. The Corcovado, a mountain that rises opposite Chilöe, is said to be studded from its foot to the snow line with large groups of these beautiful trees. Of all other vegetation the Araucaria forests are as bare as the pine woods, offering but few plants which can interest the botanist. Steep rocky ridges, where there is no water, are its favourite habitat."

The Chilians eat the seeds either raw, roasted, or boiled, and consider them very nutritious; they also procure a spirit from them by distillation. The timber is easily worked, and takes a high polish. Pavon mentions a peculiar fact connected with the height of these trees. He asserts that the female is by far the largest, frequently 150 feet, while the male seldom exceeds 40 or 50 feet. The inner bark of the trunk is peculiar from its light porous nature; it is very thick. The outer bark is also of a great thickness, and of a similar corky consistence.

The Bunya-Bunya, *Araucaria Bidwilli*, Hook., is a noble tree, inhabiting the scrubs between the Brisbane and Burnett Rivers, between the 26 and 28 parallels of latitude, and longitude 152° to 153°·30 east. On the east coast of Australia the trees grow in dense forests over a tract of country ranging about thirty miles long by twelve broad, where they form one of the principal features in the surrounding vegetation, being strikingly contrasted by their rigid growth and bright green colour. The

tree is a magnificent one, growing from 100 to 200 feet high, with a stout trunk, scarcely tapering, and covered with a thick smooth bark, often unbranched for half the height, with a conical loose head, overtopping all the other trees of the forest. The branches are arranged in whorls, sometimes giving off near the summit as many as sixteen in a whorl; these branches average twelve feet in length, and about one and a-half inches in diameter. The young branches are arranged horizontally on the stem, but the older ones have a drooping habit. The branchlets are disposed in pairs, opposite, about eighteen inches long, very slender, sparsely covered with the thin long leaves; in the younger and terminal branches the leaves are more crowded. The cones are very large, quite the size of a man's head, and sometimes nearly as broad as long, the top often slightly depressed. The scales are large and thick, with an acute ridge running across them, terminating in a sharp-pointed recurved spine. The seeds, seated between these scales, are also very large, frequently from one to two inches long, and sometimes even longer, and quite three-quarters of an inch wide, broad at one end and tapering at the other. The cones are produced on the uppermost branches of the tree, and one cone frequently contains as many as 150 seeds, which are freely scattered on the ground as the cone ripens. The trees bear fruit plentifully once in three years, usually between the months of January and March. At these seasons the aborigines assemble from far and near to collect the seeds, which are a favourite food with them. They roast them in the shell, crack them between two stones, and eat them while hot. In flavour they somewhat resemble roasted chesnuts. So well does this food agree with them that they are said "to grow sleek and fat" upon it. That part of the district where these trees most abound is called the Bunya-Bunya country.

The trees are protected by an act of the Colonial legislature, forbidding their destruction under heavy penalties, as they form one of the natural sources of food of the natives. One of the most remarkable things connected with these trees is the division of them as personal property among the various tribes, each tribe owning a particular group, which passes from generation to generation as an hereditary right, and, with the exception of these, they are not known to possess any property in a similar manner. The wood is very fine and close-grained, of a lightish yellow colour, sometimes beautifully veined; it is very durable, is easily worked, and is susceptible of a high polish.

The Brazilian Araucaria, *Araucaria Brasiliensis*, Rich., is found growing at a great elevation, chiefly in the province of

Minos Geroes, and to the north of Rio, at an altitude of 1000 feet above the sea-level. They are exposed to some of the most violent storms, accompanied by the fiercest of lightning, from the effects of which the trees suffer considerably—their beauty and symmetry being greatly lessened by the stripping off of their lower branches, or the shivering of the younger and more tender parts. The height of the tree itself adds greatly to the chances of injury, as it attains from 70 to 100 feet, having a very straight trunk, which is covered for the most part with a smooth bark, except near the summit, where the remains of old leaves still persist, as on the trunk of *A. imbricata.* In its habit it is more loose and spreading than that species, but more nearly resembles it than any of the other species. From the date of its introduction in 1819 to 1822, *A. Brasiliensis* and *A. imbricata* were considered as one species. In the latter year, however, M. Richard, who had paid some attention to the two plants, published a description of this species, separating it from *A. imbricata,* and giving the plant its existing name of *A. Brasiliensis.* He states in that account that the chief botanical difference is, that in this species the seed is entirely devoid of the winged appendage, which is a distinctive mark of *A. imbricata.* The disposition of the branches also was made a character for distinction, as well as the greater softness and whiteness of the wood. The branches are arranged in whorls round the stem, but much more numerous than the other South American species. The form of the leaves s linear-lanceolate, very sharp at the apex, from one to two inches long, not so thickly disposed upon the stem as in *A. imbricata.*

The cones are more close and compact than those of that species; they are of a dingy yellow colour, about six inches long. The scales are of a soft, corky nature, thick, and wedge-shaped, very closely packed together, each having a long recurved spine. In general appearance, this tree is much more spreading and loose than *A. imbricata,* and it makes a more rapid growth. It is not hardy enough to bear the frosts of our winters, but thrives well in a greenhouse. The nuts, or seeds, are commonly sold in the markets of Rio Janeiro, as an article of food. The resinous matter which exudes from the trunk, mixed with wax, is much used by the natives in the manufacture of candles. Two species similar to this have been described: the first by M. Savin, under the name of *A. Ridolfiana*—this has been proved by Professor Parlatore to be nothing more than a form of *A. Brasiliensis.* The second by Professor Parlatore, who has given it the name of *A. Saviana,* and considers it a very distinct species. This plant is growing in the Botanic Garden of Pisa, where it was

planted in the open air in 1846, and is now a flourishing tree. It may also be seen growing in the Botanic Garden of Florence, in both of which it has borne cones. These, in their young state, strongly resemble *A. Brasiliensis*, with the exception that the spines of the scales are much longer, very uniformly recurved, and curling so far back as to completely cover the junction of the two scales. So dense are the spines on these young cones that the scales are completely hidden by them, and the cone much more resembles a fine head of Fuller's teazel than the fruit of a Coniferous tree. In the mature cone the scales are much more fully developed, and the spines have the appearance of small recurved hooks.

The newest of all the Araucarias, and perhaps one of the most remarkable, whether as to its place of growth or its habit, is the *A. Rulei*, Muell. This was first known in England in 1861 or 1862, when small specimens of the foliage were received by Sir W. J. Hooker, at Kew. The native habitat of this species is very limited; the whole of the trees as yet discovered occupying a radius of only half a mile, and this on the summit of an extinct volcano, where the changes of season produce the greatest extremes of drought and heat, or rain, and cold winds, and where no other vegetation exists for hundreds of feet below. It grows on a parallel lat. with *A. Bidwilli*, but situate at double the elevation of the habitat of that tree. It was discovered and introduced from Port Molle, by Mr. W. Duncan, collector to John Rule, Esq., of Victoria, in honour of whom Dr. Mueller has given it its specific name. It is a tree rising some 50 or 60 feet high, branching in like manner to *A. imbricata*, but the branches more thickly arranged round the stem, and these of a more rigid and tabular form, forking in all directions, at equidistances, in a most symmetrical manner. The leaves are very closely imbricated, of a dark shining green colour. Its nearest affinity is with *A. imbricata*, which it resembles in a remarkable degree in many points, but in others it is wholly distinct. Its beauty is said far to surpass the last-named species, or even of any other species known. The cones are nearly spherical, the scales about an inch broad, terminating with a long projecting narrow point, or scale, about an inch long. Of the economic uses of this species nothing is yet known, though it is probable the seeds are eaten like some of the other species. Mr. W. Bull, the well-known nurseryman, of the King's Road, Chelsea, introduced this rare plant into this country.

The following, from an account of two Araucarias, one of which is *A. Rulei*, is given by Dr. Mueller, in his report on Lieut. Fitzalan's expedition:—"*A. Cunninghami*, found on Cumberland Islands, occurs southward to the vicinity of the Hastings

River. The branches, with immature fruit, gathered during the Burdekin expedition, accord fully with others from Moreton Bay, Rockhampton, and the Hastings River. It remains as yet unascertained whether more than one Araucaria belongs to the East Australian flora. Mr. Fitzalan offers on this pine the following notes: Very abundant from Percy's Island upwards. On Percy's Island it differs but little from the Moreton Bay pine, except in the invariable regularity of its branches—these being in regular tiers, opposite. The Moreton Bay pine is seldom so. As we go further north, this regularity increases, and the foliage becomes more glaucous, until, at Port Molle and on Whitsunday Island, the tree assumes the habit of the New Caledonian species, the tree being conical, the tiers of branches perfectly regular, and having a slight droop at their tips. We cut a spar of it on Magnetical Island, to make a top-mast, and the wood was hard and close grained, paler than that of the Moreton Bay pine, and would not swim. It produces a white resin abundantly."

HABITS AND HAUNTS OF THE BROWN AND BLACK BEARS OF THE HIMALAYAN MOUNTAINS.

BY A. LEITH ADAMS, A.M., M.B., F.G.S.

The European brown bear (*Ursus arctos*), although at one time common in many parts of Europe, is now restricted to a few secluded valleys in the Alps, Pyrenees, and mountains of Norway and Lapland. The dark-coloured race, long considered a distinct species, under the name of the European black bear, together with the barren-ground bear of North America, are now included among the varieties of *Ursus arctos*. The distribution of the brown bear is more extensive than any of the family. In Asia it inhabits Siberia and the Altai as far westward as Japan; when the Altai is crossed, and the great Himalayan chain examined, there will be found another brown bear, which has been named the Isabella bear, from the prevailing light fulvous or Isabella colour of the fur. There is a condition, common to all the above, and more or less apparent at every stage of the animal's growth, which is a light or white coloured collar; this is very distinct in the young or unborn cub, and in particular during the shedding of the long winter coat in midsummer; consequently it was from a specimen procured at that season that Cuvier described his "Collared bear." It would seem, moreover, that the fur on the front of the chest is lighter than on other parts of the body in almost

every member of the family, just as other markings—to wit, spots and stripes—can be more or less traced throughout otherwise very dissimilar species of the same group.

As to the distinction between the *Ursus arctos* and the Isabella coloured bear of the Himalaya, it will be found that the difference rests only in the colouring of the tips of the hair, and that, we have frequently observed, is not always a sure criterion, as we have procured many specimens of the bear in which the fur was in every way similar to that of the other. No doubt the majority of the Isabella bears have the tips of the hairs brownish white, but brown is the fundamental colour. Some individuals, especially old males, are almost maroon, whilst others vary from brown to brownish yellow, and are a dirty white; hence travellers speak of the "White and Brown bears of Cashmere": it is evident, however, that neither age nor sex determine the colour with any degree of accuracy. We have frequently remarked, however, that the lighter coloured individuals were mostly observed in spring, and at high elevations, as if the long sojourn among the snow had brought about the change in the tips of the hairs. In the Himalayan brown bear the senses of sight and hearing are not nearly so highly developed as smell, in which it would appear the animal's safety mainly depends. This peculiarity seems more or less constant in every member of the family. There are few quadrupeds supposed to be more inactive in habits than the bear; but this is a great mistake, and has arisen doubtless from observing the inmates of menageries and zoological gardens: when aroused to exertion in the wild state, it will scamper along a mountain side at a pace equal to the sharp gallop of a horse, and in ascending heights would certainly soon outstrip any of its plantigrade congeners. When the first skin of this bear was brought to Europe, and described by Dr. Horsefield, it was supposed from the curved and sharp claws that the animal is an expert tree climber: this, however, we can vouch for, is not the case; moreover, as a rule, the claws are not very acute, but well adapted to maintain a sure footing on the slippery mountain sides and glaciers.

The Isabella bear is found on the mountains of Armenia, where it has long passed under the name of the "Syrian bear," and is perhaps the animal referred to in the Bible; a few still linger on the Lebanon, and from the continued intercourse between Egypt and the East, it is highly probable that this is the species mentioned by ancient historians as the "Lybian bear." It is not rare on the Caucasus and high ranges of Persia, Affghanistan, and Himalaya, at least as far eastward as Nepaul, and probably much farther.

Its extreme northern limits have not been accurately de-

fined; it abounds on all the high ranges forming the water-sheds of the great rivers of Hindoostan, and is essentially Alpine in habits, whatever it may have been in bygone times; at present it is seldom found under 8000 to 10,000 feet above the level of the sea. Like its European congener it is fast disappearing before the march of civilization. Nowhere was the animal more abundant, until late years, than among the snow-covered peaks and upland valleys of the Northern Cashmere ranges. In the Vale of Wurdwun as many as thirty were killed during the spring of 1851 by one hunter; and in the same neighbourhood, two years subsequently, we procured upwards of twenty in a few weeks. The native name of the bear is *Reech,* not Ritch, as frequently written; it is also called the *Harput,* and *Balu,* names by which the black bear is also known. The Isabella bear swims with ease, and has been known to cross many of the most rapid mountain streams. In spring, after issuing from its winter retreat, its food consists mainly of grass, green pine-cones, the tender shoots of divers sorts of wild rhubarb, and umbelliferous plants then just appearing above ground; but as the season advances, it grows more dainty, feeding on the root of the wild strawberry, and a small white carrot, which it digs up with its snout and paws. At first, when food is scarce, it has been often known to attack sheep, goats, even cattle and ponies; we have frequently watched individuals prowling in the neighbourhood of a flock of sheep, in spite of the loud clamours of the herdsmen, who informed us that additional shepherds were necessary to protect the herds in the spring season, in consequence of the bears and wild dogs being then more predatory than at other times. It is fond of crunching whatever stray bones may happen to come in the way; we have seen an Isabella bear gnawing the tops of the cast antlers of a deer, and often noticed antlers similarly mutilated lying about in the forests of Cashmere. Major Young, 37th Regiment, an indefatigable and experienced Himalayan hunter, informed us that he killed an Isabella bear devouring a hind of the Cashmere deer (*Cervus Wallichii*), which in all probability it surprised when bringing forth young, as a newly-born fawn was lying by the mother's side. It has been known to devour the carcase of its own species, and the bodies of ibex, musk-deer, etc., engulphed in avalanches are greedily sought after when the snow melts in spring, and the devastating epidemics among cattle, brought on from starvation and severe winters, furnish it with abundance of animal food at a time when its system requires support. The winter's coat is shed about midsummer, when the old hair and under wool, called *peshmena,* hang in matted masses on its sides. The bear's *peshmena* is not at-

tained until autumn, and after the new coat has gained considerable length. It is analogous to that of the wild and tame goats and sheep of Thibet, and more or less pervades all the quadrupeds of the high and snowy ranges; moreover, the pheasants, partridges, finches, and other birds have their winter plumage remarkably soft and downy. We need scarcely remark that it is this substance which forms the celebrated Cashmere shawls. The *peshmena* of the ibex is softer than that of the tame goat of Thibet. Although larger and more powerful than the black bear of the Himalaya, the Isabella bear readily turns tail when confronted by its rival. We have often watched two individuals unconsciously approaching each other even within a few yards, when, as soon as they became aware of their proximity, with a grunt sable bruin rushed on his foe, whilst the other beat a hasty retreat, and only distanced his pursuer among rocky and precipitous parts, where the brown bear always finds himself the better cragsman; we have often come accidentally upon Isabella bears asleep on snowdrifts and in hollows of glaciers, where the animal is fond of basking in the heat of the day, chiefly for coolness, but also to escape annoyance from insects. In spring it feeds at all hours, but when strength and vigour return, and supplies are ample, it prefers the night and cool of the morning, possibly for the same reasons. Its fur is infested by a large flat parasite, which evidently occasions great discomfort and irritation, driving the animal to seek ponds and rivers, where it bathes frequently. The dimensions of the Isabella bear vary considerably, old males sometimes measure 7½ feet in length, and stand as high as 3½ feet at the shoulder. The average length, however, is about 6½ feet, and 4 to 4½ for a she-bear. It is generally distributed over the Alpine forests, and when it regains its vigour in spring seldom remains long in one locality; there are, however, certain individuals (usually old males) that select spots where they remain for years, most commonly a steep ridge running up to a bed of snow, where the animal's den is situated, whilst below, a pool or spring in a shady situation, serves its wants for drinking and bathing; such hermit bears seldom roam far from their retreats, and by constantly treading in the same footprints, wear out hollows on the softer soil, like "steps of stairs," which may be seen extending in unbroken succession for long distances.

Several killed by us were all very old he-bears, with their teeth considerably worn, and not a few had the canines broken or worn down to a level with the other teeth, whilst the molars were perfectly smooth on the crown. It would appear that the bears of other countries, and several other animals, such as the lion, tiger, deer, etc., when old take themselves to

retired places. This is an important fact, to be kept in view by geologists in connection with the cave remains of the large extinct quadrupeds. As to the boldness and ferocity of this bear, it may be remarked, that it seldom ever stands on the defensive; we have often seen natives approach wounded individuals, and beat them with sticks, whilst all Bruin attempted was to turn his hinder quarters towards his assailant, and moan most lustily; like its congeners, however, it is very tenacious of life, and unless wounded in a vital spot, is almost certain to make its escape. The power of vision of the bear is by no means strong, especially in spring, after it has left its den; at that season, provided the wind is favourable, an expert hunter may get within a few yards; we have actually walked up to a bear and stood before it as the animal continued to browse upon the tender shoots of plants, quite unconscious of our presence. This defect is not the result of stupidity, for when the animal scents man, all its energies are instantly called into play. On examining the eyes of several killed in spring, we have often noticed a hazy condition of the cornea, which was especially remarked in those reared by natives. This opacity may be the result of disease of the organ during hybernation, or perhaps the animal is subject to ophthalmia in the wild state, as is frequently the case in domesticated bears. We have been often astonished in witnessing the extreme acuteness of its power of smell, even at the distance of a mile: when the wind is favourable an individual may be often observed to start suddenly as if alarmed by some unfriendly sound or object, and in a wild and excited manner rush about with its head raised snuffing the wind, until satisfied by repeated trials that all was not right, when, turning tail, it scampers off at a rate few observers would credit who have only seen the inmates of a zoological garden.

The Thibet, Malayan, and Bornean bears represent the genus Helarctos, or Sun bears. The first (*Ursus Tibetanus*) is a native of the lower Himalayan ranges, decreasing as we ascend, and disappearing entirely with the forest region. The geographical distribution of this species has not been clearly fixed, and it is unfortunate that Thibet should have been selected as its habitat, inasmuch as neither that elevated region, nor Ladakh, are frequented by the animal. The Thibet bear is said to be found in Persia, Affghanistan, and Northern China, but we are not aware that it has been traced with any degree of accuracy eastward of Nepaul, or westward of the Indus. The white mark on the front of the chest, more or less apparent in almost every species, but particularly so in that under consideration, is shaped like the letter Y, the two legs proceeding a short distance up the side of the shoulder. The

general colour is a fine and glossy black, with a white spot on the lower lip, and large bushy whiskers. There is a variety we have seen among the Sewalik hills, along the frontiers of the Punjaub, having the latter spot rust coloured, with a tinge of the same on the paws. All we examined of this variety were relatively smaller than the others, a circumstance which might be accounted for in some way by the warmer climate and food in the sub-Himalayan valleys compared with the same at higher elevations. The Thibet bear, when taken young and reared, seldom attains the dimensions of wild individuals. The adult often measures 5½ feet from the snout to the root of the tail. The favourite haunts of the bear are the thick forest jungles in the neighbourhood of cultivation, where it spends the day, and issues forth at dusk to feed on Indian corn, fruits, etc. It climbs with ease, and is often seen perched on the highest branches of walnut and other fruit-trees. On making its descent, and in particular when alarmed, it will let itself "go by the run." Among the dense jungles along the sides of the Duchinpara and other great valleys leading from the Vale of Cashmere, both this and the last species often repair in the autumn to feed on walnuts and other fruits. It is said by the native hunters that as the Isabella bear cannot climb he waits until the other ascends, and then feeds on whatever black Bruin knocks down. It feeds mostly at night, repairing to dense forests and jungles at daylight. The farmers of the lowland valleys dread the destructive propensities of the black bear more than any other of their four-footed foes; in consequence, they erect platforms in the fields, where watchmen are posted at night beating drums and making loud noises to frighten the unwelcome intruders. Bruin, however, soon gets accustomed to the sounds, and like the wild boar, pays very little attention to such demonstrations. Like its brown congener, certain individuals repair to secluded places, where they spend their days much in the same manner, contenting themselves with whatever wild plants are procurable in a short circuit around their retreats, and invariably choosing the neighbourhood of some tank or spring, where the even tenour of their ways becomes apparent from the deep impressions on the ground leading to and from their dens.

The Thibet bear is decidedly herbivorous, and seldom, unless when pressed by hunger, will eat flesh. Like the Isabella bear, it delights to bask in the sun, but only during the colder months; the great heat of many of the valleys in midsummer drives it to seek shelter in the jungles and forests. Its fur is thick and long in winter, but does not contain much of the under wool called "peshmena." Like many other species, it is partial to honey, and in eating ripe walnuts it crunches

them between the jaws, rejecting the shells with great nicety. In districts where food is procurable in abundance it may be seen in undiminished numbers throughout the winter. We have been frequently assured, however, that the she-bears repair to dens soon after the first fall of snow in December, and are rarely seen until the end of February, when generally accompanied by one, sometimes two, and rarely three cubs. It would appear, therefore, doubtful if this species does hybernate; at all events it is not an universal habit. When come on unawares, especially if accompanied by its cubs, it has been known to attack man and inflict severe injuries. Like other species, the mode of attack is by a rush towards its opponent, then rearing on its hind legs fells him to the ground with its paws. Sometimes it secures its victim, and after a desperate hug or bite, scampers off into the nearest jungle. We have frequently witnessed individuals when suddenly alarmed by the report of a gun, or otherwise, rush down the steep, but as if not content with the rapidity of the stampede, would coil themselves in the form of a ball, and bound down the incline for several hundred yards; if brought to a standstill by a projection or shelf, they would spring to their feet, and hastening to the edge of the declivity, once more gather themselves into a round mass and roll to the bottom. Towards the end of October, after this bear has fed on fruits and grain, like its congener, it becomes very fat. The native hunters state that the kidney fat is useless as an article of commerce on account of being tainted with the smell of the animal's urine. They accordingly preserve only the external adipose on the loins and inside of the thighs.

The fossil remains of bears found in the Upper Tertiary formations and caves of Europe and America lead to the belief that there at one time existed certain species either now extinct or belonging to larger races than any now met with. Moreover, the same may be said of several of their contemporaries belonging to such, as the hyæna, tiger, elephant, deer, etc.; for instance, the great cavern bear, the cave tiger, the mammoth, and Irish elk. Comparing the dimensions of living and extinct bears, it seems that the great cavern bear and the species or race of the brown or fen bears, that infested Europe even in the early historic times, approach nearest in size, whereas there is a greater difference in respect to the relative dimensions of the largest individuals of the existent brown bear and the fen bear of England, showing that the large individuals have died out, or that the race has greatly deteriorated. We believe, however, that among the present denizens of northern Asia and the Isabella bear of the Himalayan, specimens can be procured equal in size at least to the largest

bears yet found in the bogs and superficial drifts. It must, however, be remarked, with reference to this point, that the very old and very large Isabella bears form a small proportion in comparison with the lesser sized individuals, and comprehend for the most part the denizens of the caves we have before alluded to, where, in all probability, many end their days, and their remains are frequently enveloped in calcareous drippings, or other deposits.

Climate and modes of life doubtless play important parts in producing the external appearances of individuals called varieties; for it is not unreasonable to believe that by curtailing the liberty and changing the food of a wild animal, by driving it to seek new haunts and subsistence, which in its former condition it would probably have eschewed, we are establishing a new order of things in its economy, which in process of time is likely enough to affect its physical developments. On the other hand, it would seem fair to suppose that when animals are unmolested in their native haunts, and allowed to follow their own inclinations, with abundance of food suited to their growth and calculated to maintain them in full vigour, they occupy their natural position in creation; whilst by becoming restricted to narrower limits, and associated with man, or other dominant races, by whom they are driven to modify their habits of life, and compelled to submit for successive generations to degrading influences, it is only in accordance with every-day experience to conclude that a deterioration of race will result, but whether to the extent of producing changes in the form of the skeleton as well as in the dimensions and outward appearances of the animal, have not yet been clearly demonstrated.

CLOVELLY.

BY HENRY J. SLACK, F.G.S.,

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Clovelly is without doubt one of the most remarkable places in the terraqueous globe. It is to an extraordinary degree queer, quaint, and beautiful. How it came to be at all is a mystery, requiring a combination of all the sciences to explain. When the visitor arrives within the precincts of its sunny woods, unless a wrinkle of blue smoke happens to curl among the trees, and the smoke suggests an unseen chimney, and the invisible chimney suggests a possible house, and the possible house suggests a possibility of lodgings, the prospect, though æsthetically beautiful, is not quite consolatory after a ride of eleven miles from Bideford to the edge of a precipitous hill, at the base of which fringed waves are playing, while flapping sea gulls and long-necked cormorants fly by. "Please, sir, I can't drive any further, but will show you the way to the lodgings," was the unexpected exclamation of our Jehu, as he pulled up in the situation described. Our party of three burst out laughing at this comical termination of a ride. In a moment a call and whistle from the driver brought a man up from the depths below, and to his care the vehicle and luggage were consigned, while we followed our guide to find Clovelly town. Where was it? Not down the green chasm immediately in front of us, as we faced the sea; for through the branching trees and thick waving ferns we could discern enough to decide that no house more elaborate than a rabbit's burrow lay in that direction between us and the mermaids' parlours that might be found beneath the glittering wave. Our guide plunged into a steep lane with bright red marly banks, and blocks of protruding stone. Trees grew on both sides, and flowers thick as in a garden. Down we went, joggling over rough stones, and after getting a hundred feet lower, between a walk and a stumble, we came to a broad stone staircase, and this, with its accompanying cottages, was Clovelly town. In days of yore, before Improvement came this way for the benefit of its health, the staircase was not in anything like its present state, but a breakneck mountain path, like a wriggling stony sheep track, occupied its place. Now, from the pretty white cottage occupied by the carrier at the top of the glen, down to the beach, 200 feet below, the stairs extend, beginning with an imposing width and breadth, and narrowing as they twist down to the coast. Clovelly houses are built on each side of this staircase, on landings; some have forecourts and some have

not, while many of the poorest cottages display fuchsias growing up their walls that would be highly honoured in less favoured climes. The Clovelly stairs are puzzling formations for strangers to walk up or down. They are much too broad to be taken in single successive steps, one for each descent. Each stair measures some variable and unequable multiple of a pace, and is, moreover, a steep inclined plane, diversified by gutter arrangements, the stones of which stand up like *snags*, and trip up any one who does not take heed unto his ways. Visitors stumble and boggle up and down Clovelly town, and feel disgusted with themselves, and envious of the natives, who—the women especially—glide skyward or seaward as though possessed of some mode of motion unknown to mortals born upon the flats.

We lodge very comfortably at Mrs. Marshall's, on stair number 33, and opposite us is a little opening called the "Square," across which we see hanging woods and the richly varied coast on the eastern side of Bideford Bay, with the Exmoor range in the distance, about twenty-six miles off in a straight line. In another direction our view is over the sloping roofs and gable ends of cottages lower down the stairs, and then across the sea to Baggy Point, and Morte, the end of the latter promontory with its "stone," terrible in the annals of shipwreck, being out of sight. Commencing above the village, and winding across several hill sides and valleys, is the road called the "Hobby," cut out of the rock, and traversing woods of remarkable luxuriance and beauty, composed of oak, beech, sycamore, firs, etc. To the west lie other woods, the park of Clovelly Court, and fine headlands with precipitous or sloping cliffs, in which the stratification is well displayed.

Clovelly is a charming place for a landscape artist, as it exhibits more colours than "Iris purfled scarf can show," and they vary magically under the changing influences of sun and cloud. A few days' residence in such a spot ought to be sufficient to emancipate any one, who has eyes to see, from the conventional prejudices and silly criticisms that hamper and damage our landscape art. One very striking fact, equally noticeable in many other parts of Devon, is the distance at which local colour is distinctly seen. When the sun catches the cliffs of crimson marl five or six miles off, they literally glow with the deeply-tinted light. Patches of spring corn shine like strips of pale green velvet at twice that distance, and fields on the slope of Exmoor, five and twenty miles away, are frequently to be discerned of a dull green hue, varied by dark lines of stone hedge-rows* and trees. In other and

* The fences are a mixture of hedge and stone wall. The latter is the fundamental structure, but so taken possession of by vegetation as to give it a hedge-like aspect.

hotter countries distant objects are much sharper in definition, and, so to speak, *harder* in tint. In Devon the magical blending of distinctness with softness is unsurpassed.

Geologically, Clovelly is situated on the millstone grit which underlies the coal measures—very imperfectly developed in Devon,—and under this general title of the formation rocks of considerable lithological difference are comprehended. The stratification has been subjected to powerful and complicated disturbances. It is plain, on the most casual inspection, that when the beds were last made they were remarkably well shaken. In many instances the strata are nearly vertical, and numerous cases occur—two remarkable ones a little west of the pier—in which hard firm beds of siliceous and aluminous stone have been bent like twigs into round arches, both inverted and erect. Angular arches are likewise common, and several adjacent cliffs have their strata thrown into a series of V or W shapes, mostly upside down. Further to the west, at Hartland Point and Quay, the rocks are less varied in colour and the hills more barren, but wilder and grander than at Clovelly. Near the latter place a wreck recently occurred, and when the tide is low the skeleton fragments of a ship caught in the sharp-toothed jaws of dark rocks, and surrounded by splashing foam, tells—at the time this is written—a striking story of the perils of the sea. The strata vary in texture from hard compact stones to easily splitting shales, with occasional marl. At Clovelly the colours are purple, brown, yellow, red, and grey; the natural tints are heightened and still further varied by the ironmould action of trickling water, and by glorious patches of orange lichen (*Squamaria murorum*), bright enough to be seen for miles, when many square feet of rock are covered with this gorgeous plant. The first artist who will do simple justice to these coasts will have his reward, if he perseveres. Of course the critics, whose eyes have never been purged of London smoke, will declare the most faithful transcript of what exists, to be "wrong," "impossible," "absurd," etc.; but when they have sung this song long enough, they will try another, laud Mr. ——'s genius and insight to the skies, and claim to have been the first to recognise his merits and proclaim how true to nature was each stroke of his brush.

Clovelly is a splendid home for ferns. How many species could be discovered in shady lanes, rocky clefts, and roads that range from the sea level to nearly 600 feet above it, only a very practised collector would venture to say. The most prevalent kinds are the lady fern, the broad fern, the male fern, the *Blechnum boreale*, the hart's tongue, and the black spleenwort, and *Polystichum aculeatum*. Of these the "ladies" grow with wonderful luxuriance, and the broad ferns, with wide

spreading fronds four and five feet long, are worth coming all the way from anywhere to see. Wherever the ferns grow flowers abound. At the end of May blue bells and rose lychnis were the most conspicuous, and in quantity sufficient to be noticeable half a mile off. With June foxgloves came in season, richer in the colour of their crimson-purple bells than the garden sorts, and commonly as high as a tall man. Near the coast sea pinks swarm, together with shepherd's purse. Lichens abound, the hairy sorts (*Usnea hirta, florida,* etc.) make a thick matting on the trees; the "oak lungs" (*Sticta pulmonaria*) is frequently found in the woods both east and west of the village, and is a very striking object, looking like extensive patches of oak leaves, some green, some brown, growing out of the bark. The cup lichens, which form beautiful low-power objects for the microscope, are plentiful in the Hobby, and rocks facing the sea are often covered with the scaly species, white, drab, yellow, orange, and black. Mosses vie with lichens in covering the banks and trees, the most conspicuous being the feather sorts, and the Polytrichums, with their flowers and long-stalked urns.

Fungi are no doubt found in considerable variety. We saw several sorts, and had practical experiences of three kinds. First, on the high ground near Hartland we gathered the giant puff-ball in its young state, when certain botanical writers pronounce it an epicurean luxury. We tried the experiment, telling the presiding genius of the kitchen, who was astonished at our desire to feed upon "toad-stools," to take off the outer skin, cut the balls into slices and delicately fry. The result was the appearance of a pretty-looking dish on our breakfast-table, and a jury of three was empowered to try the important case. The first decision was embodied in unanimous exclamations of "how nice, just like omelette, or fine batter." Second thoughts were less favourable, and a sickly aftertaste induced the experimenting triad to give up the "toad-stools," and resort to other food.

Our second fungoid adventure was in the Hobby woods one evening, when the clouds gave us a respite after some thirty-six hours of pelting rain. On arriving at a bend in the road our noses were greeted, but not gratified, by a stream of perfume not at all recalling gales from the "spicy shores of Araby the blest." The abominable and peculiar character of the stench suggested its probable origin, and a slight search revealed the offender to whose agency is was due, for among the more respectable but rank vegetation, up stood an impudent stinkhorn (*Phallus impudicus*) in the shape of a stout drab coloured column, ornamented with honeycomb markings, and surmounted by a nightcap of oval form. How "any

mortal mixture of earth's mould" can diffuse such a concentrated essence of abominations, vegetable chemistry may try to tell; but if any one has smelt the sylvan beauty he will easily comprehend Miss Plues' story of the gentleman who was driven from a favourite walk by an odour which he conjectured came from the decomposing bodies of animals that had died in the crevices of the rocks, but which really emanated from the un-Rimmel like laboratory which the stinkhorn had set to work.

Another day we brought in from the woods a small club-shaped fungus about an inch and a half high, and of a fine orange-yellow colour. As soon as it was placed under a three-inch object-glass it was seen to scatter a quantity of extremely fine threads about a hundredth of an inch in length. Mr. Berkeley was kind enough to give me the name of this fungus, *Cordiceps militaris,* and from him I learn that the emitted objects were threads of sporidia escaping from the *asci,* or bags, in which they are situated in the Sporidiiferous division of fungi. Under a magnification of 400 linear, the threads were seen to be very delicate tubes, containing patches of a whitish substance, some round, some oval, some square, and looking like a minute chain of irregular cells. The threads of sporidia did not appear to tumble out of the *asci,* or to be blown out by the air currents of the room. They escaped from all parts of the fungus and in various directions, as if ejected by an infinitesimal force.

In lanes between Clovelly and Bleckbury the *Osmunda* grows six feet high, and near Hartland Quay (eastward) is a beautiful patch of splendid *Asplenium marinum,* provokingly out of reach. The hay-scented fern is found in the Hobby woods, together with many interesting varieties of species less rare.

The shores of Clovelly are not very good for collecting specimens in marine zoology. The rocks and stones to the left are more splendid in appearance than convenient as dwelling-places for sea creatures. Some pools are prettily fringed with green weeds, common coralline, polysiphonias (good for the microscope), tangle weeds, etc.; but the compound polyps and polyzoa do not take to them, and few of the elegant tribe of sea slugs were found by us crawling on their clefts, or under sides. Some magnificent anemones—*crassicornis* and *Anther cereus*—were found at Clovelly and Hartland; the acorn barnacle was in millions on the rocks, together with swarms of tops and lesser whelks. A purple spotted top (*Trochus ziziphinus*) began to lay eggs as soon as it was placed in a washhand basin. They were discharged in ribbons of jelly, each egg, a round white opaque body, having its own separate envelope of a material transparent as the finest glass.

Near Hartland the dodder grass is plentiful on the furze, giving it a crimson tint, seen a long way off; and at Milford is a fine waterfall, making a descent of about 90 feet, and when seen from the beach, with a grand black rock mass behind, it is singularly picturesque. Rock plants of four or five kinds are in abundance, and probably many more might be found. At Clovelly the most noticeable is the pennywort, with its well known thick, round, dimpled leaves, and tall racemes* of wax-like flowers, not often seen in such perfection. London pride grows in wild profusion in the Hobby walks. Damp rocks in the roads are sure to be covered with the common liverwort, and the lycopodium shaped liverwort may be discovered nestled amongst feather mosses in wet clefts.

No description of Clovelly could be pardoned if it omitted the peculiar and interesting inhabitants of the comical stone stairs. Nobody seems to be rich in the little place; the best off are connected with the shipping that visits the bay, and next come the owners of the fishing vessels, who have unfortunately not had a lucky season for many years. The principal cottages let lodgings, and a few families fill the picturesque crack in the rocks when its season begins. Little favoured by fortune so far as her brilliant gifts are concerned, the Clovelly people are yet a distinguished race. No one can live a day on the stone staircase without perceiving that he is in a village of ladies and gentlemen. The girls have graceful figures, walk elegantly, and carry their pitchers to and from the fountains with unconscious but artistic skill. They all dress well; tawdry finery, and its natural ally, dirtiness, are both unknown, and many a London lady might advantageously exchange dress, form, and gait for those of a Clovelly damsel carrying a basket through the street. The men are manly-looking fellows, with frank, brown faces; in old specimens handsomely carved by sea and breeze. A bright, pleasant-mannered schoolmistress is the instructress of the girls, who seem to do credit to her care, and a big basket of beautiful children could be collected in five minutes on the rocky stairs.

Why Clovelly people are thus distinguished from the chaw-bacons and clodpoles to be found no great way off, could no doubt be traced to several causes. In the first place, they are evidently of a good race, and in the second place, their wits have been sharpened for successive generations by the risks and dangers of their amphibious life. Lastly, though few are well off, the majority seem well fed, and in former years the coast fishery was a profitable trade, as it may become again, whenever the fishes think proper to take excursion tickets for

* A form of inflorescence when the flowers are furnished with pedicels arranged at intervals upon a common axis.—Henslow's *Dict. Botanical Terms.*

the purpose of visiting these shores. All the villagers seem industrious, and they are very obliging, without a tinge of the servility too often found elsewhere. Of the internal life of the place a visitor can discern little, but the good folks seem intimately bound together by their common staircase, and by other ties.

Devonshire used to be famous for its superstitions; how much of the popular faith in weird wonders lingers in Clovelly we do not know, but one old woman who is lame with one leg owes her calamity to the credulity of her youth. At that time a girl of the village was declared to be possessed by the devil, and under the management of a local preacher, a ceremony of exorcism was performed in the presence of numerous witnesses. Prayers and exhortations, together with the howlings and contortions of the patient, brought the spectators to a high pitch of excitement, when suddenly the chief operator declared that the Evil One was skurrying through the bacon rack, making fast for the door. The crowd rushed back, and the old woman, who now goes lame, damaged her ankle by an unlucky fall.

This brief and imperfect sketch of Clovelly may be wound up with a few words on its climate and accommodation. Any tourist or visitor who has pretty strong legs, and is given to climbing, will be delighted with it. The New Inn, though small, is of good repute, and has serviceable vehicles and horses for hire. The lodging houses only number some half dozen. One or two are nicely furnished, and the rest are supplied with indispensables. Provisions of good quality are easily obtained by a little management, and learning the ways of the place; while any article not supplied by the village shops —which strangers would not always discover without assistance—can be had by ordering it through the carrier, who makes frequent journeys to Bideford. A little stream, locally and oddly termed a "lake," runs down the right side of the stone staircase. This tiny torrent, which is flushed once or twice a day, carries off rubbish and helps to keep the village healthy. East winds are pleasant companions, having somehow lost their sting. W., and S.W., and N.W. winds do not get sufficiently into all parts of the cleft in which Clovelly is built, but a good blow can nearly always be obtained on the hills, or on the beach. Those who can stand a moderate amount of fatigue, and like to be out of doors for hours together, need have no difficulty in getting an appetite; but the old or feeble will find the stairs and hills too much for them. Those who like fish must look sharp after it, as what is caught immediately passes into the hands of dealers, or "fish jowders," as they are termed, and dispersed through other towns by the help of donkeys, provided with panniers, who toil patiently up the stone stairs.

DIRECT VISION SPECTROSCOPES BY DOUBLE INTERNAL REFLECTION.

BY A. S. HERSCHEL, B.A.

In the manufacture of prisms for spectroscopic purposes the principle of double reflection, adopted in the construction of the ordinary pocket sextant, can be employed for correcting the deviation of the ray, which usually takes place in its passage through a prism. This discovery, as it appears to be of some importance, as well as novelty, will be treated in the following article with rather close attention to mathematical detail; but it is hoped that it will not on this account be any the less acceptable to readers of the INTELLECTUAL OBSERVER.

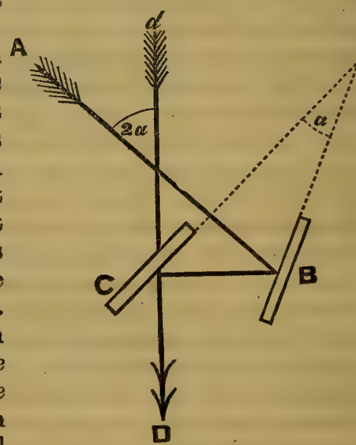


FIG. 1.

In the common sextant a ray of light from a distant object (A), falling in succession upon two plane mirrors B C (Fig. 1), is deflected from its course in such a manner as to be brought to coincide with the direction of a ray of light arriving from another distant object, *d;* when both objects become visible together in the field of a small telescope at D. The angular distance between the two objects is then *double of the angle contained between the two mirrors;* and is read off on the sextant upon a scale of equal parts, by a vernier and index revolving with the mirror B. To apply this construction to the removal of deviation from the refracted ray in spectroscopic prisms, two reflections of the ray must be made to take the place of those of the pocket sextant, within the material of the prism. These internal reflections are in general total, and have the advantage over those of an ordinary sextant in occasioning no loss of light.

Suppose a prism of glass, A C D (Fig. 2), to be traversed, in any manner, by a ray of light S *a* D E, with a deviating angle amounting to 2 × A. This deviation will be completely removed by intersecting the prism by a plane, A B, making the angle A equal to half the deviation. At the same time the refracting angle at C must be increased by the whole amount (2 A) of the original deviation. The prism A C D is then replaced by a prism of a new form, A C B, and the portion *b* D E of the refracted ray is removed to *c d e.* The two internal reflections revolve the ray within the prism through *twice the angle* (A).

At the same time the prism-face C D has been revolved an equal amount. The ray is therefore refracted under the same circumstances as before, at its emergence, *but emerges parallel to its original direction,* D E *parallel to* S *a*.

It is evident that if i e are the original angles of incidence and emergence in the *un*corrected prism, these will still remain the angles of incidence and emergence when the deviation is removed. In this case $i + e =$ C C being the principal refracting angle of the corrected prism.* It is essential for distinct spectroscopic vision that these angles i and e, of incidence and emergence, should be equal to one another, and the deviation of the ray (in the uncorrected prism) a minimum; for otherwise the image of the spectrum is blurred, and the dark and bright lines are undistinguishable. In that case our last equation becomes $i = e = \frac{C}{2}$. It will be found on examination of the figure that the angle of *first internal reflection* also becomes equal to either of the three angles named in this equation. The angle of first internal reflection is therefore

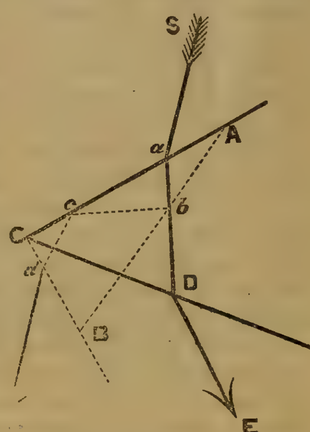
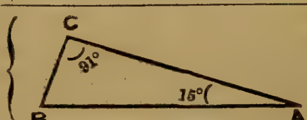
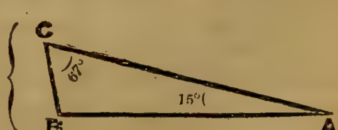


Fig. 2.

TABLE I.

Index of refraction of the glass.	Least angle (A) of the prism.	Least angle (C) of the prism.	Extreme forms of prisms with least possible angles A and C.
1·4	15° 5′	91° 16′	 Fig. 3.
1·5	15 26	83 36	
1·6	15 41	77 20	
1·7	15 46	72 4	 Fig. 4.
1·8	15 45	67 30	

Scale of angles for a direct vision prism, in which first internal reflection takes place at the "critical" angle of the glass. The angles A and C have their least possible values consistently with no loss of light.

* General formulæ of calculation are given by M. Radau in the number of the *Moniteur Scientifique* for March 15th (Vol. vi. p. 259).

equal to half the principal refracting angle of the corrected prism, C. It is therefore evident that for spectroscopic purposes the principal refracting angle, C, of a direct vision prism *cannot be made less* than twice the *"critical angle"* of the glass employed in its construction (unless the glass be silvered) without involving a loss of light. The limiting form of such prisms has a nearly constant angle A equal to $15\frac{1}{2}°$, and an angle C varying from 67° to 90° for every kind of glass (see Figs. 3, 4). In Table I. the angle of *first internal reflection* is equal to the *"critical angle"* of the glass.

For spectroscopic purposes no advantage is gained by diminishing the angles C and A in the manner now supposed. The angles of incidence and emergence, as well as the original uncorrected deviation, and the dispersive power of the prism are all diminished at the same time. When on the contrary C is increased A increases, and with it the dispersion of the light. The angle of first internal reflection always remains equal to the semi-vertical angle of the prism, or equal to half C. When the latter angle, together with A, makes up 90 degrees the prism becomes isosceles, and the *second* internal reflection no longer takes place (see Fig. 5). A natural limit is therefore placed to the increase of the values of these angles, however desirable, and, therefore, to the dispersive power of the prism.

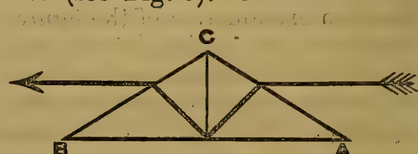
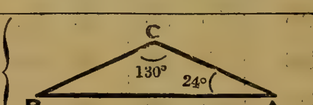
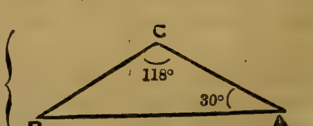


Fig. 5.

Long before the natural limit is reached the field of view becomes narrowed and contracted. Table II. exhibits the *greatest possible* angles

Table II.

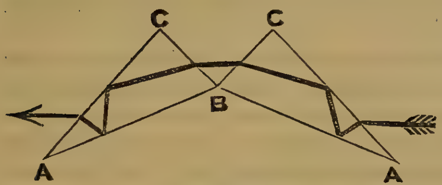
Index of refraction of the glass.	Greatest angle (A) of the prism.	Greatest angle (C) of the prism.	Extreme forms of prisms with greatest possible angles A and C.
1·4	24° 48′	130° 27′	 Fig. 6.
1·5	26 43	126 34	
1·6	28 17	123 26	
1·7	29 37	120 46	 Fig. 7.
1·8	30 43	118 34	

Scale of angles for a direct vision prism, in which the second internal reflection disappears. The angles A and C have the greatest possible values for double internal reflection.

which prisms for direct vision spectroscopes can have, and beyond which the second reflection disappears.

With a glass of high refractive power, as, for example, 1·66, the *right-angled prism,* and the compound spectroscope composed of *two such prisms* (Figs. 8, 9) holds a mean place between the extreme forms of the two preceding tables—the angle A in this prism being equal to 20° (between 15° and 30°), and the angle C is 90° (instead of 75° or 120°).

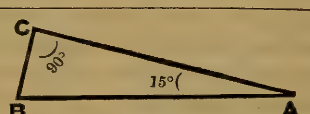
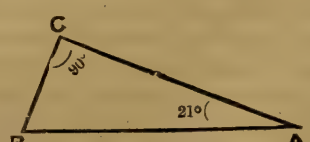
C = 90°
A = 20°
IG. 8.



C = 90°
A = 20°
FIG. 9.

This form of prism is more simple of construction, and may be distinguished from the other more complicated forms by the name of the "*three-to-one* right-angled prism," because for common glass, the longest side is to the shortest side of the triangular section of the prism, in the ratio of very nearly three to one. The following are the values of the angle A in this prism, for every different kind of glass:—

TABLE III.

Index of refraction of the glass.	Angle A, for a 3:1 prism.	Angle C, of ditto.	Forms of 3:1 prism for different kinds of glass.
1·4	15° 0′	90° 0′	 FIG. 10.
1·5	16 52	90 0	
1·6	18 47	90 0	
1·7	20 25	90 0	 FIG. 11.
1·8	21 52	90 0	

Scale of angles for the three-to-one right-angled (direct-vision) prism for different kinds of glass.

THE INFLUENCE OF FORESTS ON CLIMATE.

M. Becquerel has recently brought this interesting question before the French Academy. The first portion of his paper gives details respecting the extent of forest land in France at various periods; the second discusses the climatic action of forests, and in it he states that their influence will be found to depend on their extent, the nature of the trees, whether having deciduous or permanent leaves, on the power of evaporation exerted by the leaves, and on their capacity of receiving or radiating heat, and lastly on the character of the soil and subsoil.

The effect of trees in giving shelter against winds is obvious and important. Their leaves are a powerful and incessant cause of moisture in the air, the least reduction of temperature occasioning a precipitation of the moisture evaporating from them, and which on falling penetrates the soil directly, when it is permeable, and through the intervention of the roots when it is not.

By means of the electric thermometer the temperature of trees has been observed for many years, and it appears that the trunk, branches, and leaves grow warm or cool in the air, as is the case with inorganic bodies; but in the north the mean temperature of trees is a little higher than that of the air. When tree trunks reach three or four centimetres in diameter they do not acquire their maximum temperature till after sunset. In summer this occurs about nine o'clock, while the air is warmest about two or three, according to the season. Variations in temperature take place very slowly in trees, and rapid changes of air temperature have no influence on them. When the leaves cool themselves by nocturnal radiation they retake from the body of the tree the heat which they lose. About six in the morning the temperature above a tree, and at one metre below it, in soil situated N. or S., is equal. Hence we may conceive how trees that have been warmed by solar radiation may act on the temperature of the air, and not lower it as much as has been supposed.

With regard to the influence of destroying the trees* of a country on its mean temperature, M. Boussaingault concluded from his own and other observations in tropical America, that abundance of forests and moisture tend to cool a climate, while dryness and aridity favour heating of the soil. On the other hand, Humboldt, discussing thermometrical observations made

* Our neighbours have the convenient word "*deboisement*," for which we want an equivalent. *Untreeing* might not be thought elegant, but would be intelligible. "Disforesting" would do, but it has a legal signification.

over an area of 40° long. in N. America, found that the mean temperature of a locality is not changed by the destruction of its forests. But though the mean temperature may be unaltered, the distribution of heat at given times may be affected so as to produce a modification of climate, and Humboldt considered that the destruction of trees ought to occasion an augmentation of mean temperature by removing several causes of cooling action.*

Up to the present time sufficient attention has not been paid to the influence of the soil exposed by tree destruction. The temperature of a soil varies according to whether it is dry or moist, calcareous, sandy, or clayey, and experiments show that two soils, one wet and the other dry, exposed to solar radiation, will differ 6° or 7° Cent. when the air temperature is 25° Cent. or 77° Fahr.; and for humus (vegetable mould) the difference will sometimes be as much as 12°. The physical character of the soil is likewise important; land covered with flints does not cool so fast as sand, and flinty soils are on this account found better for vines than chalky or clayey soils, which cool quicker. The destruction of trees in a region having a siliceous or silico-calcareous soil produces a maximum elevation of temperature. Thus, western Europe owes the mildness of its climate to warm currents which arrive from the deserts of Sahara, and if terrestrial changes should convert these deserts into forests, its climate would be more severe. In America we find the tropical regions occupied by vast forests, immense savannahs, and great rivers, which cannot produce hot air-currents like the Sahara desert, and soften the climate of the north. Thus, at equal latitudes, North America is colder than Europe, as we see from the direction of isothermal lines, and from its agriculture.

The influence of forests on the quantity of running water in a country is very important; but it is extremely difficult to say *à priori* whether the destruction of part of a forest will augment this or that spring or river. We only know the result after the forest has been cut down. Springs in general are due to infiltrations of rain water, which traverse the soil until they reach an impermeable layer, down which they run, if it be inclined, until they escape as streams or fountains. Such springs are usually found amongst mountains, but forests contribute equally to their formation, not only by means of the moisture which they produce and condense, but likewise on account of the obstacles they impose to evaporation from the soil, and by the action of their roots in rendering soils permeable.

* In connexion with these inquiries, Professor Tyndall's researches on the action of atmospheric humidity in arresting radiation should be considered.

Strabo tells us that it was necessary to take great care lest Babylon should be invaded by the waters. The Euphrates, he says, became swollen in spring, when the snows melted on the mountains of Armenia, overflowed its banks, and would have submerged the cultivated lands if the superabundant water had not been drawn off by canals like those of the Nile. This state of things no longer exists. M. Oppert, who travelled through Babylonia a few years ago, reports that the quantity of water transported by the Euphrates is much less than it was in former ages, that its banks do not overflow, that the canals are dry, and the marshes become so during the summer heats. The change, he assures us, has been produced by the destruction of forests on the mountains of Armenia. Choiseul Gouffier could not find the river Scamander in the Troad; although it was navigable in the days of Pliny, its bed is now dry, and the cedars are gone that once covered Mount Ida, from whence it arose.

M. Boussaingault informs us that the valley of Aragua, in the province of Venezuela, situated at a little distance from the coast, is closed on all sides. The rivers which run into it do not reach the sea, but give rise to the Lake of Tacarigua, which, according to Humboldt, experienced at the beginning of the century a gradual diminution, of which the cause was unknown. The village of Nueva Valencia, founded in 1585, was then only half a league from the lake, while in 1800 it was 2700 toises from it. In 1822, M. Boussaingault learnt from the inhabitants that the waters of the lake had risen, and that land formerly cultivated was then under water. For two and twenty years the valley had been the scene of sanguinary struggles during the war of independence, the population was decimated, the ground uncultivated, and forests, which grow with great rapidity in that climate, occupied a large portion of the soil. These are the principal facts which M. Becquerel brings into view.

GESTURE LANGUAGE AND WORD LANGUAGE.

"GESTURE language and word language" are the titles of some very interesting chapters in an important work by Mr. Edward Burnett Tylor,* who brings before the public a class of facts, not indeed new, but very little known, and not, we believe, previously placed in a philosophical light. "Gesture language" —how little does the term convey, except to the few who are acquainted with its remarkable character and development. All nations use gesture more or less, as a means of communicating their ideas. In infancy and childhood it forms a very important part of the signs by which feelings are made known and thoughts communicated; and while the adults of some races—like the English—acquire the habit of repressing and limiting its use under natural or conventional restraints, others —like the French and Italians—can scarcely recite a single fact, or express the commonest emotion, without an amount of gesticulation that indicates the real or supposed inefficiency of mere words to gratify their desire of communicating to others what they know or feel themselves. Nor does the quantity of gesture employed by civilized races afford any indication of the capacities of their various languages. The English, with a copious and remarkably rich language, use little action; while the Germans, with a similar language, admitting of a greater range of combination, use more gesture; and the Italians exceed the French, notwithstanding that the former have one of the richest and the latter the poorest language of the Latin stock. The infant expresses itself by gesture and inarticulate sounds. Infantile races have few articulate sounds and employ gesture, not as a mere adjunct to, but as an essential portion of their speech. Hence the question arises in the minds of those who believe that man has worked his way up from humble beginnings to his present stage of civilization, whether gesture language preceded word language in the order of development, and whether, after all, the ultimate and universal speech should not be sought in pantomimic action rather than in set forms of words.

It is not to be supposed that any race of people ever existed who did not make sounds the definite means of indicating objects or expressing thoughts; but until some progress is made in processes of inflection or agglutination, articulate sounds are the materials out of which a language may be compounded rather than language itself. Any one

* *Researches into the Early History of Mankind, and the Development of Civilization.* By Edward Burnett Tylor, Author of "Mexico and the Mexicans." Murray.

who has trained a dog, or used the services of a trained dog, understands the sounds he makes in reference to particular incidents and occasions, so that a particular bark or growl gives information which, within certain limits, is definite and precise. Analogous facts may be observed by resting quietly near a rookery, or at the base of cliffs where sea gulls build. It soon becomes obvious to the observer that the birds attach definite meanings to certain sounds, and thus, like the dogs, they are in possession of some elements of language; but we should not expect, if we were gifted with the faculty of thoroughly comprehending their speech, that we should detect any grammar in it, and find verbs to conjugate or nouns to decline. The civilized and educated dog acquires, from contact with man, ideas and thoughts that do not belong to the life of any wild animal. To a very considerable extent he learns human language, so far as it applied within his hearing to matters he can comprehend, and if he had the faculty of imitating it like a parrot or a jackdaw there can be no doubt he would use it to express his acquired ideas. What he really does is to improve his own voice language, and gesture language too, and there is a strongly marked difference between the power of expression professed by a well-bred, well-educated dog, and that which is at the disposal of another dog who is badly bred and uncultivated.

The capacity for forming a language is inseparably associated with the faculty of generating thought. We need not inquire whether man can think without any sort of language, of gesture, picture, or speech to assist his efforts; but no people have ever been discovered, and probably none could exist, who have arrived at complex processes of thought, including the power of abstraction and generalization, without possessing a language capable of signifying what they meant.

A very interesting branch of the inquiry into language relates to the modes of expression adopted by deaf-mutes, and Mr. Tylor points to the important distinction—generally overlooked by the public—between "the real deaf and dumb language of signs, in which objects and actions are expressed by pantomimic gestures, and the deaf and dumb finger alphabet, which is a mere substitute for alphabetical writing." Mr. Tylor cites the following authorities in order to show how deaf-mutes naturally talk. Samuel Heinicke, the founder of deaf and dumb teaching in Germany, remarks: "he (the deaf-mute) prefers keeping to his pantomime, which is simple and short, and comes to him fluently as a mother-tongue." Schmalz says: "not less comprehensible are many signs which we do not use in ordinary life, but which the deaf and dumb child uses, having no means of communicating with others but by signs.

These signs consist principally in drawing in the air the shape of the objects to be suggested to the mind, indicating their character, imitating the movement of the body in an action to be described, or the use of a thing or its origin, or any other of its notable peculiarities." "With regard to signs," says Dr. Scott of Exeter, "the deaf and dumb child will most likely have already fixed upon signs by which it means most of the objects given in the above lesson (pin, key, etc.), and which it uses in its intercourse with its friends. These signs had always better be retained by the child's family, and if a word has not received such a sign, endeavour to get the child to fix upon one. It will do this most probably better than you." The Abbé Sicard is quoted to a similar effect. He did not invent signs for his deaf and dumb pupil, of whom he said that by a happy exchange he taught him the mimic signs of his language, in return for the written signs of the French tongue. Kruse, a deaf-mute,* is also cited: "Thus the deaf and dumb must have a language, without which no thought can be brought to pass. But his nature soon comes to his help. What strikes him most, or what makes a distinction between one thing and another, such distinctive signs of objects are at once signs by which he knows these objects, and knows them again; they become tokens of things. And whilst he silently elaborates the signs he has found for single objects, that is, while he describes their forms for himself in the air, or imitates them in thought with hands, fingers, and gestures, he developes for himself suitable signs to represent ideas."

In the Deaf and Dumb Institution of Berlin, Mr. Tylor tells us that 5000 signs are stated to be employed—far exceeding the number of words used by the most ignorant classes in this country—and of these he took down about 500 of the most important. The sign for *I* is pushing the forefinger against the pit of the stomach; for *thou*, it is pushed towards the person addressed; for *he*, the thumb is pointed over the right shoulder. "When I hold my right hand flat, with the palm down, at the level of my waist, and raise it towards the level of my shoulder, that signifies *great*, but if I depress it instead, it means *little*." The motion of taking off the hat indicates a *man*, a *woman* is denoted by laying the closed hand upon the breast, and a *child* is signified by dandling the right elbow upon the left hand. "The adverb *hither*, and the verb *to come* have the same sign, beckoning with the finger towards oneself. To hold the first two fingers apart like the letter V, and dart the finger tips out from the eyes, is to *see*. To touch the ear and tongue with the fore-finger is to *hear*, and to *taste*. . . .

* Mr. Tylor speaks of him as "a teacher of deaf-mutes, and author of several works of no small ability."

The outline of the shape of roof and walls drawn in the air with two hands is a *house*; with a flat roof it is a *room*. To smell at a flower, and then with two hands make a horizontal circle before one, is a *garden*. To pull up a pinch of flesh from the back of one's hand is *flesh* or *meat*; make the steam curling up from it with the fore-finger, and it becomes *roast meat*. Make a bird's bill with two fingers in front of one's lips, and flap the arms, and that means *goose*; put the first sign and these together, and we have *roast goose*."

The gesture language has no inflections, and is so far like the Chinese, but it has a system which Mr. Tylor explains. He tells us that the deaf-mute arranges his words in a certain order without reference to the spoken language custom of the country to which he belongs. For black horse he says by his signs *horse black*; for bring a black hat, *black hat bring*; for I am hungry, give me bread, *hungry me bread give*. The general rule is that a deaf-mute begins with that which he thinks most important, "for instance, to say my father gave me an apple, he makes first the sign for *apple*, then for *father*, and lastly that for himself, dispensing with the verb."

There is no difficulty in perceiving that a good many ideas may be communicated by means of this gesture speech, but it is astonishing to what perfection it has been carried. Mr. Tylor cites from the *Justice of the Peace* for Oct. 1, 1864, a remarkable will, of considerable complication, dictated by a deaf-mute. He signified by gestures that he wished all his property to go to his wife at his decease, and that if she died during his daughter's lifetime, it was to pass to the daughter, and in the event of her death, to her husband, if he was the survivor; and if both died, then to their children. To make this last provision intelligible, he first repeated the signs for his son-in-law and daughter, and made other signs to signify their deaths. To indicate the children he placed his right hand a short distance from the ground, and raised it by degrees, and as if by steps, which were his usual signs for pointing out their children, and then a sweeping motion expressed the wish that all should come in.

Mr. Tylor informs us that, "in the Berlin Institution, the simple Lutheran service, a prayer, the gospel for the day, and a sermon, is acted every Sunday morning in the gesture language for the children in the school and the deaf and dumb inhabitants of the city, and it is a very remarkable sight. No one could see the parable of the man who left the ninety and nine sheep in the wilderness, and went after that which was lost, or of the woman who lost the one piece of silver, performed in expressive pantomime by a master in the art, without acknowledging that, for telling a simple story, and making comments

upon it, spoken language stands far behind acting. The spoken narration must lose the sudden anxiety of the shepherd when he counts his flock and finds a sheep wanting, his hurried penning up the rest, his running up hill and down dale, and spying backwards and forwards, his face lighting up when he catches sight of the missing sheep in the distance, his carrying it home in his arms, hugging it as he goes."

Passing from gesture language as in use amongst cultivated deaf-mutes, Mr. Tylor traces its employment by various wild tribes, who come into contact with each other, but who do not understand each other's spoken language, and shows how they have followed the same principles in devising appropriate signs as are in use in the Berlin Institution, or in other gatherings of deaf-mutes. He likewise refers to the gesture language employed by the Cistercian monks to mitigate their absurd rule of self-mortification, which interdicted speech except upon religious matters, and shows, by reference to a dictionary collated by Leibnitz, how closely their signs resemble those made by the deaf and dumb.

The question of the extent to which spoken languages bear traces of the same processes of thought and reasoning that are shown in the construction of gesture language, is a highly curious one, which, if carefully worked out, must have an ethnological as well as a philological value. Mr. Tylor supplies some very interesting reflections on this subject. He likewise enters into an inquiry concerning the existence of tribes who cannot communicate with each other by words only, but need to supplement their spoken language by that of signs. It is very difficult to ascertain such facts beyond a doubt. The use of gesture does not necessarily show that ideas could not be conveyed to other persons without it, but we think it highly probable that some savage tribes should possess more ideas than they have invented articulate sounds to express, and that when they have to be represented it must be in the gesture or pictorial form.

It must be remembered, that the deaf-mutes who have gone so far in the construction of a gesture speech, have done so under the constant stimulating influence of persons who know how to observe, to think, and to speak. In dealing with persons deficient in any one of the five senses, it is, as Mr. Bird, the blind surgeon, has so well shown in reference to those afflicted with loss of sight, essential to their development that they should come freely into contact with educated persons in a normal state. Left alone, the deaf-mutes would have had few signs, because they would have had little knowledge and few ideas. By showing them objects they would not have noticed of their own accord, and imparting ideas

they could not have possessed without external aid, a necessity has been created for them to extend their gesture language; and we can only expect to find such a language highly developed under circumstances that favour an amount of intellectual development considerably above that of the lowest races of mankind, and which also render spoken language impossible, as in the case of deaf-mutes; or inapplicable, as where American Indians are in the habit of meeting with tribes whose language they do not know, and have no facilities for acquiring.

Thus, though gesture language may stand in order of development before articulate speech, it could only reach its point of culmination long after articulate spoken language had made considerable advances.

THE ROMAN POTTERIES AT DUROBRIVÆ.

BY THOMAS WRIGHT, F.S.A.

(*With a Coloured Plate.*)

In the flat low district, where the river Nen forms the boundary line between the counties of Huntingdon and Northampton, are found two adjacent parishes and villages, one on the Northamptonshire side of the river, called Castor, the other, on the Huntingdon side, known by the name of Chesterton. Castor is distant about four miles and a-half west from Peterborough. Both these names furnish, combined with its position on one of the most imposing of the Roman lines of road, the Ermyn Street, undeniable evidence that this locality has been the site of a Roman settlement of some importance; and accordingly, accidental discoveries first, and afterwards excavations carefully planned and executed, brought to light the remains of a town of some extent, which, to judge by the foundations, and by the occurrence of tesselated pavements, must have consisted of large and handsome houses. But that which gave still greater interest to this place was, that it was found to have been once a great establishment of potteries—a sort of Staffordshire of Roman Britain; and not only was abundance of the pottery made here found scattered about, but the kilns themselves in which it was baked. It was the first well-ascertained discovery of manufactories of Roman pottery in this island. A comparison of the local circumstances with the ancient itineraries has enabled us to identify this place with the town which stands, in the itinerary of Antoninus, between

Roman Pottery from Durobrivæ.

Duroliponte, which is represented by the modern Godmanchester, and Causennæ or Ancaster, and which there figures under the name of Durobrivæ.

The man to whom we owe this discovery was Edmund Tyrrell Artis, who resided on the spot as agent of the Duke of Bedford, the modern lord of the soil. Mr. Artis was an intelligent, but a self-educated man, and, unfortunately, after publishing figures of the more interesting objects found in the course of the excavations, in a very handsome folio volume of plates,* he was never able to write the volume of descriptive text intended to accompany it; and what he had learnt on the subject has only been partly communicated to the public, in two or three casual articles, from the pen of his friend, Mr. Charles Roach Smith.† Mr. Artis calculated that he had found the remains of the kilns spread over a space of not less than twenty square miles, so that no doubt can be entertained of the great extent to which this manufacture was carried at Durobrivæ. By this discovery we first became acquainted with certain kinds of pottery which were undoubtedly manufactured in Britain under the Romans, and, as no traces of the manufacture of the same ware have been met with on the Continent, and examples of it found there are not numerous, and may therefore have been exported from Britain, we seem justified in considering it as peculiar to this island. The discovery of so many of the kilns, some of them nearly perfect, discloses to us, moreover, the manner in which it was made. Mr. Artis investigated this part of the subject with great practical intelligence.

There are some varieties of this Durobrivian ware, and two especially have been remarked; the first blue or slate-coloured, the other reddish-brown or of a dark copper colour. The latter was coloured by a simple though curious process, which Mr. Artis was enabled to investigate in a very satisfactory manner. It will, perhaps, be best told in his own words. "During an examination of the pigments used by the Roman potters of this place," he says, "I was led to the conclusion that the blue and slate-coloured vessels met with here in such abundance, were coloured by suffocating the fire of the kiln, at the time when its contents had acquired a degree of heat sufficient to ensure uniformity of colour. I had so firmly made up my mind upon the process of manufacturing and firing this peculiar kind of earthenware, that for some time previous to the recent discovery [in 1844] I had denominated the kilns in which it had been fired *smother kilns*. The mode

* *The Durobrivæ of Antoninus Identified and Illustrated*, large folio, 1828.

† These will be found in the *Journal of the British Archæological Association*, vol. i. p. 1; in Smith's *Collectanea Antiqua*, vol. iv. p. 80, etc.

of manufacturing the bricks of which these kilns are made is worthy of notice. The clay was previously mixed with about one-third of rye in the chaff, which, being consumed by the fire, left cavities in the room of the grains. This might have been intended to modify expansion and contraction, as well as to assist the gradual distribution of the colouring vapour. The mouth of the furnace and top of the kiln were, no doubt, stopped; thus we find every part of the kiln, from the inside wall to the earth on the outside, and every part of the clay wrappers of the dome, penetrated with the colouring exhalation. As further proof that the colouring of the ware was imparted by firing, I collected the clays of the neighbourhood, including specimens from the immediate vicinity of the smother kilns. In colour some of these clays resembled the ware after firing, and some were darker. I submitted them to a process similar to that I have described. The clays dug near the kilns whitened in firing, probably from being bituminous. I also put some fragments of the blue pottery into the kiln; they came out precisely of the same colour as the clay fired with them, which had been taken from the side of the kilns. The experiment proved to me that the colour could not be attributed to any metallic oxide, either existing in the clay or applied externally; and this conclusion is confirmed by the appearance of the clay wrappers of the dome of the kiln. It should be remarked, that this colour is so volatile that it is expelled by a second firing in an open kiln." Mr. Artis proceeds to inform us that these kilns, so many of which were discovered, were "all constructed on the same principle. A circular hole was dug, from three to four feet deep, and four in diameter, and walled round to the height of two feet. A furnace, one-third of the diameter of the kiln in length, communicates with the side. In the centre of the circle so formed was an oval pedestal, the height of the sides, with the end pointing to the furnace mouth. Upon this pedestal and side-wall the floor of the kiln rests. It is formed of perforated angular bricks, meeting at one point in the centre. The furnace with bricks moulded for the purpose. The side of the kiln is constructed with curved bricks, set edgeways in a thick *slip* (the same material made into a thin mortar) of the same material, to the height of two feet." Fortunately, some of these kilns remained almost entire, and many had been left with the pottery partly packed in them for firing, so that there was no difficulty in understanding the nature of the process here employed by the Roman potters. Mr. Artis goes on to say, "I now proceed to describe the process of packing the kiln, and securing uniform heat in firing the ware, which was the same in the two different kinds of kilns. They were

first carefully loose-packed with the articles to be fired up to the height of the side walls. The circumference of the bulk was then gradually diminished, and finished in the shape of a dome. As this arrangement progressed, an attendant seems to have followed the packer and thinly covered a layer of pots with coarse hay or grass. He then took some thin clay, the size of his hand, and laid it flat on the grass upon the vessels; he then placed more grass on the edge of the clay just laid on, and then more clay, and so on until he had completed the circle. By this time the packer would have raised another tier of pots, the plasterer following as before, hanging the grass over the top edge of the last layer of plasters, until he had reached the top, in which a small aperture was left, and the clay nipt round the edge; another coating would be laid on as before described. Gravel or loam was then thrown up against the side wall, where the clay wrappers were commenced, probably to secure the bricks and the clay coating. The kiln was then fired with wood. In consequence of the care taken to place grass between the edges of the wrappers, they could be unpacked in the same size pieces as when laid on in a plastic state, and thus the danger in breaking the crust to obtain the contents of the kiln could be obviated."*

This Durobrivian pottery has an especial interest for us, because it is covered with ornaments and figures, raised in relief like those on the Samian ware, but not like it cast from moulds. "The vessels," Mr. Artis remarks, "after being thrown upon the wheel, would be allowed to become somewhat firm, but only sufficiently so for the purpose of the lathe. In the indented ware, the indenting would have to be performed with the vessel in as pliable a state as it could be taken from the lathe." The ornamenter then took a slip of rather liquid material, and with an implement made for the purpose, formed all the ornaments and figures with the hand. The slip used for this purpose was often white, which was laid on a dark ground. "The vessels, on which are displayed a variety of hunting subjects, representations of fishes, scrolls, and human figures, were all glazed after the figures were laid on; where, however, the decorations are white, the vessels were glazed before the ornaments were added. Ornamenting with figures of animals was effected by means of sharp and blunt skewery instruments, and a slip of suitable consistency. These instruments seem to have been of two kinds: one thick enough to carry sufficient slip for the nose, neck, body, and front thigh; the other of a more delicate kind, for a thinner slip for the tongue, lower jaws, eye, fore and hind legs, and tail. There

* *Journal of the British Archæological Association*, vol. i. pp. 3—5.

seems to have been no retouching after the slip trailed from the instrument."

Of the forms of mere ornamentation of this ware, the scroll ornaments appear to have been the most popular, probably because it was the one most easily executed with freedom by the process just described. The arrangement and combination of the scrolls, which are sufficiently varied, are often both tasteful and very effective. In our cut, Fig. 1, I

FIG. 1.—Scroll Ornaments taken from Durobrivian Pottery.

have selected two examples, from among those given in Mr. Artis's plates; and others are furnished by the two examples of the slate-coloured ware, also taken from Artis, which form the centre figure and the lower figure to the right of our coloured plate. These, it may be remarked, are examples of the most common forms and shades of colours of the Durobrivian pottery.

It is, however, the figured Pottery of Durobrivæ, which presents some of the characteristics of the Samian ware, that possesses the greatest interest for the antiquary and the historian. The variety of subjects in the Samian ware is far greater, and they are treated in a more elaborate and more highly finished style of art, yet similar classes of subjects appear to have enjoyed greater popularity than others in the Durobrivian and Samian pottery, and we can hardly help suspecting that there was some design of imitating, or perhaps a sentiment of rivalry. Considering that they were only executed with the hand, and it would appear rapidly, the style of drawing is remarkably good and spirited, and, as Mr. Artis has remarked, the courage and energy of the hounds, and the distress of the hunted animals, are expressed with great skill and fidelity. But they have another and a peculiar value; when we consider that they were certainly executed in this

country, and by artists who could hardly have done otherwise than copy what was constantly before their eyes, we can have no doubt that these are all true pictures, pictures which we could hardly in any other way have obtained, of life in Britain under the Romans, and they show us, as well as could be shown in subjects capable of being represented by such artists, those occupations in which the enjoyment of life was then believed to consist. The more common of these subjects are hunting scenes, and scenes taken from the amphitheatre or the racecourse.

We have abundant evidence, in a great variety of monuments of different classes, of the love of the people of Roman Britain for the pleasures and excitement of the chase. It is sufficiently well known how, among the bones of animals which had been eaten at the table, which are found on Roman sites in England and Scotland, a large proportion testify to the presence in great abundance of the wild boar, of the wild deer (of several varieties), and of almost every animal which comes under the name of game. Britain, too, was celebrated for its dogs, and it would not, I imagine, be impossible for the comparative anatomist to reproduce the forms of the varieties of the dog known here during the Roman period from these figures on the pottery compared with bones of the dog still found among Roman remains. The Roman writers speak not unfrequently of the excellence of the British dogs, especially of the dogs for hunting, and they seem to have formed a rather important article of export. In the figures on the Durobrivian pottery, the dogs are pictured, and evidently with truthfulness, with distinct characteristics of different varieties. For instance, the dog hunting the hare in our cut (Fig. 2),

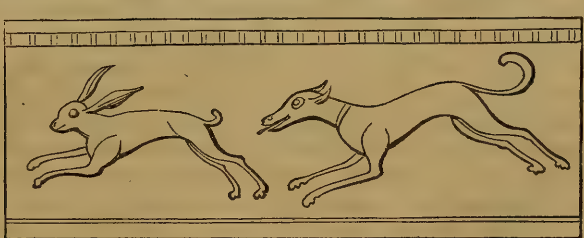


Fig. 2.—Hunting the Hare.

taken from an example of Durobrivian ware engraved in Artis's plates, must be recognized at once as a greyhound, the same variety of dog which is still used for the same purpose. It has been suggested that this may be the dog to which the Romans gave the name of *vertagus,* and which is said to have been a British dog. Martial describes it in one of his epigrams as

hunting the hare spontaneously and alone, and bring it, when killed, home carefully to its master, without damage to the body—

> "Non sibi, sed domino, venatur vertagus acer,
> Illæsum leporem qui tibi dente feret."

It is certain that the Romans valued especially the hunting dogs which they obtained from Britain. Oppian (*Cyneg.* i., 468) calls them a noble race, speaks of them as slender in form, and commemorates their other characteristics, in terms some of which might apply to the greyhound—

> "Ἔστι δέ τι σκυλάκων γένος ἄλκιμον ἰχνευτήρων,
> Βαιὸν, ἀτὰρ μεγάλης ἀντάξιον ἔμμεν' ἀοιδῆς·
> Τοὺς τράφεν ἄγρια φῦλα Βρετανῶν αἰολονώτων."

The Roman writers have not left us any very satisfactory description of the varieties of the dog, as they existed among them, and they were probably far less numerous than at present. The ancient writers, even those who treat especially on cynegetics, speak in general terms of this domestic animal, and of his faithfulness and intelligence, but say less about the special qualities of its different varieties. Nemesianus, another poet who wrote on this subject, tells us, without any particular description of them, of different breeds of dogs which came from different countries, and expressly states that those brought from Britain were remarkable for their swiftness, and for their excellence for hunting.

> "Divisa Britannia mittit
> Veloces, nostrique orbis venatibus aptos."
> Nemesiani *Cynegetica*, l. 123.

FIG. 3.—A Stag-hunt.

This description accords with the greater number of the figures of dogs represented in the hunting scenes of our Durobrivian

pottery. Our cut, No. 3, taken from a sample of this pottery given in one of Mr. Artis's plates, no doubt represents the British staghound of the Roman period. Though not dissimilar in shape, it appears to be of a stronger and larger make than the greyhound represented in the former cut. The draughtsman here appears to have intended to distinguish two varieties of the stag, in the different forms he has given to their antlers. We have a different dog in other examples, as in the group given in our next cut (Fig. 4), where a dog of apparently a much fiercer character (see our cut, Fig. 4, which is taken from a very remarkable vessel of this Durobrivian ware, now known as the Colchester Vase), appears driving before him both stags and hares. The hunting of the boar is also introduced in some examples of this pottery.

Fig. 4.—Hunting the Stag.

Gladiatorial combats are also favourite subjects on the pottery made at Durobrivæ, as on the Samian ware, and they leave no doubt that these cruel and degrading exhibitions were cherished by the Romans in Britain as well as in Italy. We have singular evidence of the prevalence of the taste for such shows in the figures on the Colchester vase. This very remarkable monument of the ceramic art in Roman Britain, which is represented, of course, on a very diminished scale in the first figure of our coloured plate, was found, in 1853, in the Roman cemetery which occupied the site of West Lodge, near Colchester. It had been used as a sepulchral urn, and, when found, contained calcined bones, and was covered with an inverted shallow vessel or dish. It may be right to state that this interesting vase is nine inches in height by six in diameter. The ornamentations consist of three groups, one of which is the flight of stags and hares pursued by a dog given in our cut (Fig. 4). The second and, perhaps we may say, the principal group represents the combat of gladiators, which appears in our engraving of the vase. It represents, in perfectly correct drawings, the two classes of gladiators, a *Secutor* and a *Retiarius*, the latter of whom, vanquished, has dropped his

trident, and raises his hand to implore the mercy of the spectators. The Secutor, with a close helmet over his head, and a short sword in his hand, advances to strike the fatal blow, unless arrested by the success of his adversary's appeal. Over the head of the Retiarius is the inscription, VALENTINV LEGIONIS XXX., meaning clearly, "Valentinus, of the thirtieth legion," which was doubtless the name of the individual here represented. A similar inscription over the head of the Secutor is read without difficulty—MEMN.N.SAC. VIIII., which is explained by Mr. Roach Smith, who considers the A in SAC as an error for E, as standing for *Memnius* (or *Memnon*) *numeri secutorum victor ter*, *i. e.*, "Memnius, or Memnon, of the numerus (or band) of secutors, conqueror thrice." There is no reason for supposing that this inscription has any reference to the individual whose remains were buried in the vase, but it has probably reference to some remarkable gladiatorial combat which had created a sensation in Roman Britain, like some one of the celebrated boxing matches of modern times, sufficiently so to have become a popular subject of pictorial representation. The drawing of the figures is so carefully minute that even the well-known nails of the shoes are not forgotten, and it is curious that the shield contains the figure called in the middle ages a filfot, which, as Mr. Smith remarks, is often found on the monuments of the Ælian Dacians, whose quarters were at Amboglanna, on the wall of Hadrian. Possibly Memnius may have been one of them.*

The third group on the Colchester vase also represents a performance which was very popular among the Romans and among the Saxons, and indeed throughout the Middle Ages, that of a bear-tamer and disciplined bear. The bear, in this case, appears inclined to be rebellious, and his keeper, whose left arm bears what appears to be a shield, and his legs and right arm protected by bands or thongs, is menacing the animal with a whip. An assistant is approaching with what appear to be two staves in his hands, for the purpose also of intimidating the ferocious animal. Over the head of the man holding the whip are the letters SECVNDVS MARIO, the intended application of which is not very clear. It has been suggested that it may mean simply that the cup was a gift from Secundus to Marius; or it may be that the bear was a pet animal, to which the name of Marius may have been given, and Marius and his master, or controller, Secundinus, may have had a momentary fame like that of Banks and his horse Morocco in the times of our James I. At all events, this remarkable vase shows what curious information relating to the condition and history

* See Mr. Roach Smith's interesting account of this vase in the *Collectanea Antiqua*, vol. iv., pp. 82—89.

of Roman Britain may be obtained from the collection and study of the figures on the pottery made at Durobrivæ.

The upper figure to the right in our plate represents a vessel in Durobrivian ware, which is preserved in the room of British Antiquities in the British Museum. The figures upon it represent a chariot-race in the Roman racecourse or stadium, the traces of several of which have been met with in the neighbourhood of our greater Roman stations. The chariot, or quadriga, has the classical form, rather rudely designed, and is drawn by four horses abreast. Other vessels of this pottery were ornamented with encounters and combats between men and men, or between men and animals. One fragment, as far as we can judge from the portion of the animal which is left, represented a man fighting a wolf, an animal then no doubt common in the forests of Britain. Sometimes the ornamentation consists of mere groups of animals, or of fishes, especially the dolphin. Birds, which were perhaps more difficult to form with the potter's slip, are less frequent.

But I will not attempt here to give anything like a list of the various subjects represented on the Durobrivian pottery, but will only allude to another class of subjects of extreme interest as coming from a Romano-British pottery. These are mythological subjects, which it must be confessed are not very common, as they are on the foreign Samian ware, but they all belong to the purely Roman mythology. A combination of deities which appears to have been most popular in the western provinces of the Roman empire was that of the gods who presided over the days of the week, which, under the Romans, commenced with Saturday (*dies Saturni*), and these gods were arranged in the following order: Saturn, Sol (or Apollo), Luna (or Diana), Mars, Mercury, Jupiter, and Venus. Works of art of the Roman period representing these divinities are found not uncommonly in Gaul, Germany, and Britain, and they appear to have been rather a favourite ornament of the Durobrivian pottery.* Fragments of several vessels with the figures of the seven gods and goddesses have been met with, from some of which Mr. Fairholt has restored the example which forms the lower figure on the left-hand side of our plate. This vessel presents also another characteristic of the Durobrivian ware, more especially employed in urns of this form. It consists of indentations made in the side of the vessel, while still soft, but after it had left the lathe, and continued with regularity round it. Sometimes, where little ornament was employed on the rest of the vase, these indentations were left quite plain; sometimes an ornament was introduced in the

* See my book, *The Celt, the Roman, and the Saxon*, Second Edition, pp. 269 to 271.

centre; and not unfrequently the indentation was formed into a niche for the reception of a figure. This is the case with the example before us, which is surrounded with ornamental niches containing the figures of those deities who gave their names to the days of the week. The one is recognized immediately as Jupiter brandishing his thunderbolt; the other appears to be intended to represent Mars. It is, perhaps, by a mere and accidental error of the potter's artist that Mars, in this instance, occupies the place of Mercury. Two other fragments of the same vessel contain the lower parts of the figures of Mercury, with his caduceus, and Diana. Perhaps these vases with mythological subjects were considered to possess more importance than the others, for they present peculiarities of colour. A fragment, containing a figure of Minerva, rather rudely executed, is straw colour, with a buff glaze. The most curious of these fragments contained part of the scene representing the mythic story of Hercules and Hesione. The figure of the sea-monster only is lost by the fracture. Hercules, with the lion's skin wrapped round his left arm, brandishes his club in the act of attacking the monster. Hesione stands naked between her deliverer and her persecutor, having apparently her hands fettered behind her, with heavy weights hanging by chains from her arms.*

It seems probable that these potteries at Durobrivæ do not belong to a very early period of the Roman occupation of the island. The style of art, and their general character, perhaps indicate a period not older than the latter part of the second century, and we cannot help thinking that the peculiar style of ornamentation originated in the desire to furnish a home-made substitute for the imported and, therefore, we must suppose, expensive Samian ware. As I have already remarked, this pottery forms one of the most curious and instructive monuments of the history of the internal condition of our island during the Roman period. Its character is entirely Roman, and in the mass of its remains, which has down to the present moment been examined, we find not the slightest trace of Celtic or Germanic sentiment.

* These fragments, which were collected by Mr. Artis, are engraved and described in Mr. Roach Smith's *Collectanea Antiqua*, vol. iv., pp. 90—93.

COLOURS OF STARS.—OCCULTATIONS.

BY THE REV. T. W. WEBB, A.M., F.R.A.S.

Every inquiry relating to stellar light possesses additional interest since the extraordinary success which has attended the investigations of Mr. Huggins. Now that he has shown the possibility of a greater approximation than could have been anticipated, to a knowledge of the constitution of these distant suns, each additional fact concerning their aspect acquires a relative value which it did not previously possess. A great step has been taken, when in the prosecution of an inquiry we have fixed a central fact to which others may be referred—a nucleus, as it were, round which our floating information may become crystallized, and settle into a definite form. Such has been the discovery of metallic and gaseous bands in the spectra of the stars. And it now becomes desirable that future researches into stellar light, whether as to its variableness in intensity or in colour, should be conducted with reference to this primary determination. A new and beautiful line of inquiry has thus been unexpectedly opened for amateurs possessed of instruments of sufficient light; and it is one which, it is to be hoped, will be carried on with the more spirit and enterprise, since it has been, as it were, committed to their care by the Astronomer Royal. The great Equatorial at Greenwich, with its $12\frac{3}{4}$ inches* of aperture, will not, it appears, be employed in these investigations, Mr. Airy having made known his opinion,† that the scrutiny of the sun's surface and the observations of star-spectra have now been taken up so well by amateur observers, that it appears to him just to leave these subjects in great measure to the private persons who have given to them such laudable attention. Mr. Huggins's extraordinary success, with considerably less than half the light, fully proves that so large an aperture is not requisite, and Mr. Browning's indefatigable exertions in perfecting the spectroscope will, we may hope, be rewarded by its more frequent employment. We must not suppose, however, that the extension of Mr. Huggins's great discovery will be found an easy undertaking. There may be little difficulty, with a sufficient aperture and well-adjusted spectroscope, in perceiving the bands already recognized, but it would be found quite another matter to follow his steps, and those of Dr.

* Such, I am informed (that is, 12 Paris inches) is its real measure, notwithstanding my supposed correction of an imaginary mistake in Int. Obs., v. 55, note.

† *Report of the Astronomer Royal*, 1865, p. 11.

Miller, in identifying them by patient and laborious measurement. As Admiral Smyth has said, in his recent interesting treatise on *Sidereal Chromatics,* "it is only on the finest nights that the lines in the stellar spectra are steady enough for measurement. Indeed, the difficulties of observation are now so complex, that the *complete* scrutiny of the spectrum of a single star may probably be the work of some years."

Fortunately, however, for those interested in these delightful studies, a subordinate, but very useful branch of the same inquiry is open to the possessors of even moderate optical means, who may do essential service by collecting data, to be used as materials in its future prosecution. We are not now referring to the phenomena of variable light, though these well merit a close scrutiny, but to those of changes of colour. This curious subject has been repeatedly brought before our readers, and we may refer them especially to a paper at page 436 of Vol. v., as enumerating some of the cautions necessary in the study of it.* But the additional interest which, as we have said, it has received from recent discoveries, induces us to revert to it; especially as the beautiful pair 95 *Herculis* described in that paper is now coming into a convenient position again. Since that time, some further remarks on these stars have appeared in the *Sidereal Chromatics* of Admiral Smyth, from the late deeply-regretted Captain Higgens, of Bedford. Thirty-eight observations between May 21 and August 8, 1864, led him to the inference that the colours were less vivid than in the previous September, and that A (the green star) showed more loss of colour than B (the red), "though neither to the extent of justifying their being classed as anything but normal, though somewhat faintish." Professor Piazzi Smyth, however, from an extended comparison of the observations of W. Struve, Admiral Smyth, Sestini, Fletcher, Wrottesley, and himself, including a series of years from 1828·71 to 1862·72, has come to the more decided conclusion that A passes through the successive tints of yellow, greyish, yellowish with blue tinge, greenish, light green, light apple green, "astonishing yellow green," and yellow again, in a period of probably twelve years, while B in the same time passes from yellow, through greyish, yellowish with reddish tinge, reddish, cherry red, "egregious red," to yellow again. Should this deduction be confirmed by testimony so extensive and accumulated as to

* Further consideration and experience have led to the conclusion that the superiority of silvered specula in such inquiries was there somewhat overrated. Since brilliant objects seen through the imperfectly transparent film acquire a blue tint, the reflected rays from which this has been abstracted cannot be perfectly white, but must be very slightly tinged with the complementary orange. The great advantage, however, of the absence of any outstanding fringe remains.

eliminate that most annoying element of uncertainty, "personal chromatic equation," and establish the alleged periodicity, here will be a truly important field for spectrum analysis. But though, in the present state of our knowledge, the Professor is fully justified in calling this "one of the most remarkable cases in the heavens," we cannot say, considering the recent date of the inquiry, that instances yet more decided may not yet remain to be disclosed.

If such phenomena attain the rank of established facts, there would seem no other way of accounting for them but by supposing that a change takes place in either—1, The composition or temperature of the luminous material, or—2, The condition of an encompassing atmosphere, or—3, The accidental interposition of unknown media in intervening space. The latter hypothesis, however, which has been suggested by Sir J. Herschel in the case of *Sirius*, is of course excluded in periodic variations; and the proof of any one such instance would go far to displace it altogether. The two previous suppositions would come strictly within the range of spectrum analysis. It is much to be regretted that with the exception of *Arcturus*, whose change of colour is very questionable, all the suspected objects are possessed of an inferior degree of light; and a material difficulty is thus introduced in the use of the spectroscope; but if this could be overcome, and if a clear instance of change could be brought under examination, it would be most interesting to ascertain whether any corresponding effect was produced upon the dark bands; and either an affirmative or a negative result would advance our knowledge of the composition of light. In the absence of any conspicuous instance, what we have now to do is to endeavour to lay so firm a hold upon less obvious phenomena as to place them beyond the reach of suspicion; and to exercise our ingenuity in devising the best means of so grappling with them. The beautifully executed diagram of tinted discs in the *Sidereal Chromatics*, will give very valuable help in training the eye to the discrimination of colour, though the plan certainly involves, as has been suggested, some use of "qualifying adjectives," since the colours of stars are frequently incapable of being referred to tints of such a simple character. Other modes of experimenting yet remain, and ought to be tried if possible.

It follows from the comparisons of Professor P. Smyth at Teneriffe, that in our latitudes no determination of colour can be strictly relied upon beyond 10° of S. Decl.; but this leaves abundant room for the inquiry; and with a view of saving trouble to those who may be disposed to enter upon it, the following suspicious instances have been selected from our

Double Star List, to which many might be added from other sources:—

δ Herculis	(No. 25,	Int. Obs.,	ii. 55.)
12 Canum	(No. 29,	,,	ii. 56.)
44 Boötis	(No. 33,	,,	ii. 133.)
σ Coronæ	(No. 37,	,,	ii. 134.)
95 Herculis	(No. 40,	,,	ii. 136.)
$\epsilon^1 4$ Lyræ	(No. 47,	,,	ii. 301.)
η Lyræ	(No. 51,	,,	ii. 303.)
μ Cygni	(No. 62,	,,	ii. 373.)
γ Delphini	(No. 63,	,,	ii. 373.)
a Piscium	(No. 80,	,,	iii. 55.)
γ Leonis	(No. 104,	,,	iii. 219.)

The following observations of some of these stars with a $5\frac{1}{2}$-inch object-glass may be added as the result of the present season: common epoch 1865·45.

δ Herculis. Pale lemon yellow and lilac, by a perfectly independent judgment. The *comes* exhibited the curious phenomenon of oscillation (see Int. Obs. ii. 375) in a remarkable degree. With a power of nearly 450, and an unsteadied telescope, the vibrations were extraordinary.

12 Canum. Pale yellow and fawn colour.

44 Boötis. On a general view, both pale yellow; yet with some not very definable difference: when more closely studied B sometimes seemed inclining to bluish, but on the whole I believe it was tawny. This was my first observation of the pair with my present achromatic, and the result a perfectly independent one.

95 Herculis. Apple green and light orange: very clearly marked.

OCCULTATIONS.

July 3rd.—8 Libræ, 6 mag., 9h. 45m. to 10h. 48m.—a^2 Libræ, $2\frac{1}{2}$ mag., 9h. 58m. to 10h. 52m.—8th, ρ Sagittarii, 4 mag., 9h. 21m. to 10h. 11m. The double occultation on the 3rd will be a very interesting phenomenon, especially as one of the stars is so large, and forms one of the members of an optical pair, Number 10 of our Double Star List (Int. Obs., i. 375).

ARCHÆOLOGIA.

THE church of BOSHAM, near Chichester, has recently been the subject of a number of paragraphs in the newspapers, on account of rather extensive restorations which are being carried on in it. Bosham is a place well known in history. It was a manor belonging to Earl Harold, the son of Godwin, who afterwards became the last of the Anglo-Saxon kings of England, and it was from hence that he sailed for Normandy, on that eventful journey in which he was entrapped into a fatal acknowledgment of the claims of Duke William to the succession of the Anglo-Saxon crown. The locality was connected with Anglo-Saxon history by other circumstances belonging to still earlier dates. It had a small monastic establishment as early as the latter half of the seventh century, when Wilfred began here the conversion of the South Saxons to Christianity. One of the daughters of King Cnut is said to have been buried in the church of this monastery, and he is supposed to have been so closely connected with it that some writers have conjectured it to have been the scene of that beautiful scene of the Anglo-Danish monarch attempting in vain to dictate to the tides of the ocean. But there are reasons for supposing that, if the story have any foundation in truth, its scene was not the sea shore, but the banks of the river Thames, at Westminster, where the later kings of Anglo-Saxon England had their palace, and that King Cnut merely went out of his palace to rebuke the flattery of his courtiers by showing them his inability even to check the advance of the tide in the river. The church of Bosham has recently been restored, and the course of the work has brought to light many portions of the original Anglo-Saxon masonry which were not previously known to exist. As many Roman tiles had been used in the building, it is probable that the church, which must have been one larger than it is at present, was raised on or near the site of a Roman establishment of some kind or other. In this older building one of the distinguishing characteristics of the Anglo-Saxon masonry, the " long-and-short work of the angles, is found in abundance, as well as some herring-bone work. Silver coins of the reign of Edward I., with an old knife, were found in the drain of an early *piscina.*

The lead mine on SHELVE HILL, in Shropshire, known as the Roman Gravels Mine, is remarkable for its bold remains of the mining operations of the Romans on this site, which have been described in a former volume of the INTELLECTUAL OBSERVER (see Vol. i. p. 295). The modern mine is now worked by a company with great success, especially since they have reached a depth beyond the extent of the Roman workings. In their progress they continually fall in with the shafts and galleries in which the Roman miners had worked, and they found in them a few objects which those ancient miners had left behind them. Some only of these have been preserved, and are now in the possession of the lord of the land, Mr. More, at Linley Hall. They consist of spades, formed by splitting very sound oaken timber, and of MINERS' CANDLES. The latter are

extremely curious, and have not been noticed till recently. The wicks are formed of hemp, and they have been made by dipping, but length of time has turned the tallow into a substance which is almost as hard and brittle as marble. It has been asserted that the ancients were not acquainted with the use of candles, and that their only method of giving light was by means of lamps supplied with oil, but these candles of the Roman miners appear to overthrow entirely this theory. And indeed, as we know that the Anglo-Saxons used candles, and from them we derive the modern use of them, and as the Anglo-Saxon *condel* or *candel* was undoubtedly derived from the Latin *candela*, there is every reason for believing that our forefathers derived the use of candles from the Romans as well as the name.

A large sepulchral TUMULUS has been opened on LANGTON WOLD, in the East Riding of Yorkshire, under the direction of the Rev. W. Greenwell of Durham. It is situated hardly more than two miles from Old Malton, which has every claim to be considered as the *Derwentio* of the Romans. It is a large tumulus, though low, which is rather a characteristic of the East Yorkshire tumuli, and is not, we think, a characteristic of an early date. The first openings, according to the accounts published, brought to light undoubted Anglo-Saxon interments, with fragments of, as we understand, cinerary ware, indicating the mode of interment which appears to have prevailed among the Anglo tribes who settled in this island. In the centre was found a rude chamber, in which a skeleton was found laid on its left side, which is certainly not, as appears to be assumed, a proof of its being an early British interment, for we have ourselves found in East Yorkshire undoubted Anglo-Saxon interments, in which the body was placed in this position, and in some cases doubled up. We are only speaking from a newspaper report, and are, therefore, unwilling to speak too decidedly, but this report does not lead us at all to think with it that the supposed non-Anglo-Saxon interments belong to a *very early* British period, and that there were at least 2000 years between the dates of the two different interments. It is contrary to the notions which history gives us on such a subject. We have no doubt that the Anglo-Saxons mixed freely enough with the Roman population they found here, and we find sufficient proofs of their burying their dead in the same cemeteries; but it is not merely improbable that an Anglo-Saxon would open the grave of a people so utterly unknown to him as the prehistoric Britons to bury a kinsman in it. We are inclined to believe, as the result of many researches and investigations, that there was a period between the perfectly Roman and the perfectly Anglo-Saxon to which a large proportion of the tumuli which are commonly called British belong; but we abstain from further remarks on this case, until the publication of the promised report of these excavations by the gentleman who has directed them. T. W.

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

ROYAL SOCIETY.—*May* 4.

ON THE PROPERTIES OF LIQUEFIED HYDROCHLORIC ACID GAS.—Professor Stokes communicated a most important paper, by Mr. G. Gore, on the properties of hydrochloric acid gas liquefied under great pressure. The liquid is a very feeble conductor of electricity, and has but a very limited solvent power for solids. Of five metalloids submitted to it only one was dissolved, namely, iodine; of fifteen metals placed in it only one, aluminium, was dissolved; of twenty-two oxides it dissolved only five, namely, titanic, arsenious and arsenic acids, teroxide of antimony, and oxide of zinc; it had no action on carbonates, and dissolved only one sulphide, that of antimony, and two chlorides, those of phosphorus and tin. These results show that liquid hydrochloric acid gas has much less action on solid bodies than the same substance when combined with water; this is very remarkable in some cases, as that of lime, where a true hydrogen acid and a powerful base, each in a pure state, and both possessing, under ordinary circumstances, a most powerful mutual affinity, do not react on one another, but remain perfectly uncombined, although one is a liquid and the other a porous solid, and they are brought into intimate contact by the enormous pressure requisite to condense the gas, forcing the liquid into the porous solid.

In consequence of the mode of experimenting, the substances operated on by the liquefied hydrochloric acid were of necessity exposed to the action of the same substance, in the form of gas, before it was condensed into a liquid; and it appears that, in many cases, the action exerted during the experiment was due rather to the influence of the gas than that of the liquid acid, which appears to be remarkably inert. As a remarkable instance of the power of glass to resist pressure, Mr. Gore mentioned that tubes charged with liquid carbonic acid in 1860 had not suffered any loss by leakage up to the present time.

GEOLOGICAL SOCIETY.—*May* 24.

ON THE DATE OF THE FORMATION OF THE ENGLISH CHANNEL.—Mr. J. Prestwich read a paper on this subject, in which he expressed his opinion that the break in the land between France and England was not the result of the last geological change, but that the channel existed at the period of the formation of the Low-level gravels of the Somme and Thames Valleys, and probably at that of the High-level gravels. During a recent visit to the Sangatte raised beach, he recognized fragments of chert in the shingle and associated sands, which he inferred were derived from the Lower Cretaceous strata; associated with them were fragments from the Oolitic series of the Boulonnais and two pebbles of red granite,

probably from the Cotentin. These facts seem to prove that, before the Low, and possibly even before the High-level Valley-gravel period, there existed a channel open to the westward, and extending between France and England. Above the Sangatte raised beach occurs a mass of chalk and flint-rubble, with beds of loam, from twenty to eighty feet thick, and containing land-shells. Mr. Prestwich considered this accumulation analogous to the loess, which it resembles in general character, while the shells found in it belong to species common in that deposit.

THE FORMATION OF THE WEALD AND THE DEPOSITS IN THE MEDWAY VALLEY.—A very interesting paper, by Messrs. Le Neve Foster and Mr. Topley, on the denudation of the Weald, was read, describing the superficial deposits of the valley of the Medway. They showed that deposits of river-gravel and brick-earth (loess) occur at various heights up to three hundred feet above the level of the river. They also gave a detailed account of those singular formations known as "pipes" at Maidstone, where brick-earth (loess), containing land and freshwater shells and mammalian remains, have been let down into deep cavities in the Kentish Rag, probably by the gradual dissolving away of the limestone by the action of rain-water containing carbonic acid.

The paper was intended mainly to show the light that is thrown upon the theory of the denudation of the Weald by a study of the superficial deposits. The authors stated their objections to the theory of fracture and the marine theory, and endeavoured to prove that the gravel and brick-earth (loess), occurring at a very great height above the level of the Medway, are old alluvia of that river. If this point be granted, it follows that the denudation has been effected by atmospheric agencies, *i.e.*, rain and rivers, and that there will be little difficulty in supposing the present inequalities of surface in the Weald to have been produced by these agents. The escarpments of the chalk, which are, upon the marine theory of the formation of the Weald, regarded as sea-cliffs, are considered by the authors as being due entirely to the difference of waste of the hard and soft formations under atmospheric denudation.

June 7.

ON THE FORMER OCCURRENCE OF THE MUSK OX IN LOW LATITUDES. A short paper, by Monsieur Lartêt and the late Mr. Christy, describing a phalange of the musk-ox (*Ovibos moschatus*), which was discovered by them in the Gorge d'Enfer. With it were found remains of *Ursus spelœus*, reindeer and aurochs, as well as worked flints, differing from those found in any other of the Dordogne caves. Monsieur Lartêt remarked that the Gorge d'Enfer is the most southern locality at which remains of *Ovibos moschatus* have yet been found, and is fifteen degrees south of its most southern limit at the present day; but reindeer remains have been found by Mr. Christy and himself further south still, on the northern slope of the Pyrenees.

PROGRESS OF INVENTION.

A New Constant Battery.—The improved constant battery of M. Blanc Filipo is deserving of attention, being well adapted for the purposes of telegraphy. It requires but one fluid, which may be a mere solution of common salt. This battery may be constructed by placing the saline solution in a tolerably tall glass jar, and adding to it powdered sulphur, so as to form a layer of moderate thickness at the bottom. The positive metal consists of a ring or cylinder of zinc, which is immersed in the fluid, but not so as to come in contact with the sulphur; and is suspended by a wire, which passes up through a cork in the neck of the jar, and forms the positive pole. The negative metal consists of a plate of lead, or tin, which dips down into the layer of sulphur—being slightly coated with sulphuret of copper, where it comes in contact with the sulphur, and covered with an insulating substance, when it approaches the zinc. A wire from this also passes up through the cork, and forms the negative pole. The mode of action of this battery is very simple. The hydrogen which is evolved at the negative pole unites with some of the sulphur—though the latter is insoluble, and a non-conductor—and forms sulphuretted hydrogen, the sulphuret of copper taking a part in the process which is indispensable, though it is not as yet understood. When the sulphuretted hydrogen comes in contact with the chloride of sodium, there results a double decomposition, sulphuret of sodium and hydrochloric acid being formed. The latter dissolves the zinc, and the resulting chloride of zinc is changed into sulphuret, by the sulphuret of sodium, which again becomes a chloride. During these changes, a small quantity of sulphuretted hydrogen is evolved; and this appears to be the only objection to which this battery is liable. In other respects, it possesses some important advantages; it is very economical, both as to the kind and amount of the substances required; it occupies but little space, and it continues in action a long time. Other metals may be substituted for the zinc; but in every case the salt used in the solution must be incapable of decomposition by sulphuretted hydrogen, or of precipitation by the metal which is substituted.

Purification by means of Electricity.—The fat obtained from bones constitutes an important article of commerce; it is, however, obtained in a state of great impurity, and its purification is extremely difficult. The idea occurred to Dr. Dullo of using electricity as a means of freeing it from the substances—chiefly gelatine—which render even what is obtained from fresh bones extremely nauseous, but which, fortunately, are decomposed by the electric current, that, at the same time, exerts no action on the fat itself. His process consists in gently heating the fat to about 40° Cent., in a clean copper vessel, free from roughness in the interior. Sulphuric acid, diluted with ten times its volume of water, is added, to an amount dependent on the degree of impurity which is to be

removed, and is well stirred in. A plate of zinc is then introduced into the mixture, and is made to come into contact with the copper vessel, at as many points as possible—the surface of the zinc being about equal to half that of the copper. The current of electricity thus produced causes a foaming, which is great in proportion to the amount of impurity; and the gelatinous constituents are dissipated in the form of gas, or are retained in the water, and removed when the action ceases. After the fat has been drawn off, it is allowed to settle; and, having been separated from the matters which subside, it is filtered, after which it is quite pure, and ready for sale or use.

New Mode of Whitening Wool.—The beautiful white wool produced in this country has long been the envy of continental manufacturers, and many attempts have been made to rival it, not altogether without success. A process recently invented in Germany seems to have left nothing further to be desired on the subject. The wool to be bleached is steeped in a strong neutral solution, containing sulphate of magnesia, amounting to the one-twentieth of the weight of the wool; and this solution is decomposed by the addition of bicarbonate of soda, equal to seven-tenths of the weight of the sulphate of magnesia—the mixture being then gently heated to about 90° Cent. Basic carbonate of magnesia precipitates, and the larger portion of it attaches itself to the fibres of the wool, rendering them extremely white, without impairing their softness; carbonic acid is evolved.

Novel Application of Capillary Attraction.—Capillary attraction has been applied by M. Duclos to the reproduction of drawings, etc., by means of processes which are founded on the fact that, if a silvered plate of copper is written on with an unctuous or resinous substance, and afterwards subjected to the action of mercury, that fluid will adhere to the uncoated portions and form projections rising considerably above them; so that, even when the excess of mercury is carefully removed, it will still remain in relief, and a copy of the plate in this condition can be taken, from which may be obtained an electrotype that, if printed from, will afford a fac-simile of the drawing. M. Duclos, in practice, replaces the mercury by a compound consisting of fusible metal and mercury. When this is melted and poured over the silvered plate on which the drawing has been made, it comports itself exactly like the mercury; but, being harder, when cold, an electrotype may be obtained from it directly. When, however, this compound is used, great care must be taken to prevent oxidation, which would be, at a subsequent period, highly inconvenient; hence the plate is immersed in sufficiently heated oil, when the fused metal is being poured upon it. An amalgam of copper, applied to the silvered plate by means of a roller of silvered copper, is also used instead of the mercury; and when it sets, an electrotype may be had from it. Various modifications are employed when plates for surface printing, etc., are required.

Photographic Engraving.—Photography has been applied in a novel way to the production of engravings. A photograph is first obtained. For this purpose some good fabric of silk is immersed

in a solution of gum tragacanth and gluten, then dried and rolled; after which it is coated with a solution of caoutchouc in benzole. It is next spread out on glass, and, having been inclosed in a frame, is left to dry. It is then sensitized with perchloride of iron and tartaric acid, and a picture is printed on it in the usual way. The development is effected by a mixture consisting of two parts double salt of gold and three parts gold in powder; a current of hydrogen is next thrown upon it to reduce the metallic salt, after which the silk is separated from the glass. The side of the silk containing the picture is now pressed against a plate of clean copper, which has been previously coated with a mixture consisting of concentrated chloride of zinc, borax, carbonate of ammonia, and gum, and has been allowed to dry until the coating becomes sticky; it is then rubbed with a damp sponge, after which the silk is drawn away. The picture remains on the plate; and the flame of a soldering lamp having been thrown upon it, it is exposed in a camera. The design, damascened in gold, is thus obtained on the copper plate; and when the latter is acted upon with a solution containing ten per cent. nitrate of silver—which does not eat under the protected portions—a film of copper is removed from the uncovered portions. The silver thus reduced is taken away by washing, and the plate is again exposed to the action of the nitrate; the same thing being repeated a number of times in succession, until sufficiently deep hollows have been formed.

Application of Heat in Mining.—The use of heat, in the crumbling down and removal of rocks, is of very ancient date; it has been latterly applied in the mines of the Hartz mountains, very advantageously, to the separation of considerable masses of ore. For this purpose, a small furnace is placed against the face of the rock containing the mineral, and the coke with which it has been supplied is kept in a state of ignition for some hours; after which the furnace is withdrawn, and the heated portion of the rock is sprinkled with water. In a short time a large mass separates, and an additional quantity not long after. On the whole, a mass several inches in depth, and of considerable weight, is thus removed, and at a cost fifty per cent. less than if gunpowder had been employed.

Erasine.—Grease, etc., is readily dissolved by benzine; but the latter has the disadvantage of an offensive odour. A new substance has, however, lately been discovered which possesses the useful properties of benzine, while, at the same time, any odour it emits is agreeable. It has been called *Erasine*, and is the product of a species of pine, accidentally discovered by some persons who were collecting turpentine, and remarked that none could be obtained in the usual way from certain trees; but instead of it, a juice possessing the power of dissolving all animal and vegetable oils, without leaving any stains, or injuring the most delicate colours. Erasine has already found its way into commerce, and it would answer well for burning in lamps, but that it is too dear.

Newly-observed Source of Magnetism.—A source of magnetism has been discovered which, it is probable, has not been remarked before; and it is the more deserving of attention since it seems to

excite permanent polarity in soft iron, an effect which cannot be produced either by touch or by the electric current. It was noticed, at the central workshop of the Nassau Railway, that not only shavings of steel, but even of soft iron, produced in the lathe, were sensibly magnetic, and that, whatever their lengths, they exhibited two poles. It might be supposed that the nature of the polarity would depend on whether the helix formed in this way turned to the right or the left; but such was not found to be the fact—though, at the same time, the effect seemed to be modified by that circumstance, as, in all those instances in which the spires, looked at from their south pole, were in a direction opposite to that in which the hands of a watch move, the magnetism was stronger than in the others. The relative position of the poles was, however, found to depend on a totally different circumstance; since the south pole was invariably situated at that extremity where the cut had been commenced; and the north, at that at which it had terminated.

New Lens for Photography.—An achromatic lens, which seems to be peculiarly suited to the purposes of the photographer, is formed by the combination of two concave menisci of crown glass, the focal lengths of which are as one to three, having between them a flint glass lens. The contiguous surfaces are of exactly the same curvature, and therefore are perfectly in contact. Such a lens is found to produce a clean, undistorted picture. It will cover an extent of about 92°; but it will define well, and illuminate uniformly an angle of 80°, with a stop one-thirtieth of its focal length; and an angle of 60°, with a stop the one-fifteenth of its focal length. It is less bulky than the ordinary lenses, and must be very durable, since both sides of the flint glass are protected by hard crown glass.

Rails of Steel and Iron Combined.—Soft iron is objectionable in the rails of railways, on account of its inferior strength and rapid wear; steel is, generally speaking, too expensive; but a means has been devised in America, a short time since, of uniting the strength and durability of the one with, to a great extent, the economy of the other. The rail is made, lengthwise, in two portions, which, when placed beside each other, and firmly bolted together, leave at the upper edge a longitudinal groove, capable of receiving and holding firmly a bar of steel. If the latter has been inserted before the iron portions have been united, a rail will be obtained in which the parts exposed to the action of the wheels is of steel; and is not only very durable but, when worn, is capable, with great ease, of being replaced, the remainder of the rail being as available for use as ever. The bar of steel being made to traverse the joints of two or more of the compound rails, it binds them together, giving great firmness, and rendering the chances of displacement of the rails almost nothing. The iron portions of each rail are so formed, with hollows and corresponding projections, that they cannot slide in any way upon or from each other; and when all the parts are united, they present an appearance differing but little from that of the ordinary rail.

THE REFLECTION OF LIGHT EMPLOYED TO INDICATE CHANGES OF TEMPERATURE.—Dr. Boulon, of Paris, uses the reflection of light very ingeniously, for the purpose of making very slight changes of temperature distinctly visible, by their effects, to a large audience. He employs a thermo-electric battery, which is so arranged that the electric current produced by changes of temperature is transmitted through the helix of a galvanometer, the needle of which has, fixed upon its centre, a very small mirror. Opposite to this mirror is a large screen, in the middle of which is a small aperture, through which a ray of light from a bright lamp behind it passes to the small mirror in front of it. When the plane of the mirror is exactly perpendicular to the direction of the ray from the aperture in the screen—that is, when there is no electric current to deflect the needle of the galvanometer—the ray is reflected back again through the aperture. But the smallest current deflects the needle, and therefore turns the mirror round in one direction or the other; and the ray, instead of passing back through the aperture, is thrown on the screen to the right or left of it. The most minute changes of temperature are thus rendered distinctly and easily, cognizable by any number of persons, in a large lecture-room.

NOTES AND MEMORANDA.

MUSICAL FROGS.—The author of that excellent book, *Ten Years in Sweden,* speaks of the *Bombinator igneus,* a little frog that has become naturalized in that country, as emitting, during the pairing season, a note like the ringing of bells. He says, "As this sound proceeds from the depth of the water, it appears to come from a long distance, although the frog may be within a few fathoms." Linnæus spoke of the same reptiles making sounds as if large bells were ringing in the distance. It would be very interesting to naturalize the little creature in this country.

NEW PLANET.—M. de Gasparis has discovered another new planetoid on the 26th of April, which, in honour of Dante, has been named Beatrix.

THE OBLIQUITY OF THE FLOUNDER.—Professor Steanstrup has obtained specimens which show that in its early stages the flounder is a symmetrical fish, with one eye on each side of its body. As it grows, both eyes pass to one side, in which they have a curious oblique arrangement. He says, "The symmetrical fish by degrees squints its eye in and up through the head out to the other side, and at last squints itself into a perfect flounder." Professor Wyville Thompson, who has recently examined Professor Steanstrup's collection of flounders in various stages, confirms the main fact, but suggests in the *Annals of Natural History* a more probable mode of effecting the change than the passage of the eye through the vault of the cranium, as conceived by Steanstrup, with whom he agrees in rejecting Van Beneden's hypothesis, that it is produced by a simple torsion of the anterior portion of the head. From various considerations, he thinks that "the eye of the blind side passes to the eye-side, not through the vault of the head, but under its integument, displacing in its progress the frontal bone on its own side. . . . The term 'migration' of the eye is of course used in a somewhat metaphorical sense. The eye changes little in *actual* position. With the growth of the fish the associated parts are, as it were, *developed past it,* producing this singular obliquity."

Preserving Star-fishes, Crustacea, etc.—Mr. Verrill, writing in *Silliman's Journal*, recommends that these objects should be immersed in alcohol of moderate strength for about a minute, and then dried rapidly by artificial heat, taking care not to let the temperature come too near the boiling-point, at which green shades change to red.

Age at which New Moon is seen.—Mr. D. A. Freeman writes to us from Menton (*Alpes Maritimes*), stating, in reply to the query of a correspondent, which we published in a former number, that on the 28th of January he observed the moon shortly after sunset, when it was but thirty-two hours old, and he was informed by the bailiff of the property on which he is residing, that about twelve years ago he saw the thin crescent of the *old* moon above the horizon before sunrise, and on the same evening, at the same height above the sea-level—from 100 to 150 feet—he saw the thin crescent of the *new* moon after sunset.

Goddard's Microscope Cabinets.—Mr. Goddard has devised, and Messrs. Ford and Sharratt have made, a new pattern cabinet for microscopic objects, one of which has been sent to us for examination. The outside of this cabinet is of mahogany, and the trays which, according to size, hold twenty-four or forty-eight slides lying flat, are of millboard, strengthened by mahogany edges. This construction enables the cabinets to be offered considerably below the price of the best mahogany patterns, and the Goddard cabinets come into competition with those of varnished white deal, which were, we believe, first introduced by Messrs. Crouch, and which were noticed in a former number. In point of workmanship, those of Messrs. Crouch appear to us the best, but the outer case being of mahogany in Mr. Goddard's pattern, is an advantage in point of strength.

Steinheil on Dividing Bright Double Stars.—In the *Astronomische Nachrichten*, No. 1525, is a letter from Steinheil, in which he remarks that "it is a known consequence of the diffraction of light that fixed stars appear as light discs of measurable diameters. These diameters stand in relation to the intensity of the light, and the proportion that exists between the aperture of an object-glass and its focal length," so that a telescope of eight inches aperture and twelve feet focal length, with which Dr. Engelmann could not divide γ^2 Andromedæ, "would necessarily give to the component stars larger diameters than one of the same aperture, and shorter focal length." Dr. Steinheil gives a diagram to show the ratio in which the apparent discs of stars—as seen through telescopes—increase in proportion to their brightness, and he states that by reducing the brightness, with the aid of a light moderator he has introduced, the discs may be diminished, and difficult stars divided. This light moderating glass is held in the hand between the eye and the eye-piece. As an illustration of the fact that dividing power increases with the ratio of aperture to focal length, Mr. Webb mentions that he has this spring seen the close pair of ζ Cancri distinctly separated with a black interval, with one of Mr. With's 8-inch silvered glass specula of 6 feet focus (power about 300), which Dr. Engelmann's achromatic of 8 (French) inches aperture and 12 feet focus would only elongate, and that not very distinctly, in April, 1864. Dembowski gave its distance about that time $= 0''\cdot5$, but this was probably too small, as it has been recently measured by Mr. Dawes $= 0''\cdot63$, and seems to have been closing up for several years. In the *Astronomical Register* for June, Mr. Dawes affirms that nothing can be easier than to prove that the diameter of star discs does *not* depend on the ratio of aperture to focal length. As Dr. Steinheil is a mathematician as well as a famous maker of telescopes, Mr. Dawes should furnish the disproof he mentions.

Respiration of Plants.—It has been found by recent experiments that carbonic acid is not decomposed by plants, even in the light, unless it is diluted with atmospheric air, oxygen, hydrogen, or nitrogen. Analogous conditions are required in other cases; thus phosphorus is not oxidized nor rendered luminous by oxygen, unless atmospheric air, nitrogen, or hydrogen also is present; neither will oxygen support respiration, but, on the contrary, will cause asphyxia, unless it is diluted.

Great Hail Storm, May 7, 1865.—In *Comptes Rendus*, No. 20, will be

found an account of the great storm of the 7th of May, as it operated in the valley of the Scheldt. The most remarkable feature was the enormous quantity of hail. M. Lermoyer states that at Vendhuile the hailstones were as large as musket-balls, at Catelet they reached the size of a pigeon's egg, and even of a fowl's egg; these great ones being composed of agglutinations of those of smaller dimensions. The storm of hail and rain began at 4h. 30m. p.m., and was accompanied by formidable whirling gusts of wind. A ditch attached to the canal of St. Quentin, and which received the drainage of 500 hectares (about 1235 square acres) of land, was so overfilled by the hail and rain as to overflow the high bank of the canal, and sweep into it 800 hectolitres of firewood, obstructing the navigation. The hail formed a congealed mass 462 metres long, and 20 in mean breadth, or about 459 yards long, and nearly 22 broad. "This deposit constituted a veritable glacier on which it was safe to walk." When a channel was cut through it, detached masses floated down like icebergs above the bridge of Vendhuile, the meadows of Ossu were covered for a mile and a-half with a mass of hailstones more than 200 yards wide. It was observed that during this storm vanes placed on heights indicated north-east currents, while those in the plains showed south-west.

On some Properties of Nitric Acid.—M. Dietzenbacher informs the French Academy that very remarkable oxydizing powers are exhibited by heating a mixture of fuming nitric acid and Nordhausen sulphuric acid. Charcoal and lamp-black burn energetically in such a mixture. The acids, mixed in equal proportions, transform cotton in a few seconds into pyroxylin, insoluble in ether or alcohol; thus prepared it burns instantly, leaving no residue. Cotton partially submerged ignites and discharges thick vapour. Zinc, which is energetically attacked by concentrated nitric acid, remains for days in the mixed acids without alteration. The mixture is equally inactive towards iron, copper, and tin; the iron does not become passive.

Preservation of Wines.—M. Pasteur recommends that the disorders of wine, which are occasioned by parasitic ferments, should be arrested by heat. He bottles the wine, wires the cork, and exposes it in a hot-air stove to a temperature of from 60° to 100° C., or 140° to 212° Fahr. The cork, which is partly driven out by the heat, is replaced when the wine cools and sealing-wax applied. M. Pasteur states that this process prevents the action of the ferments, and has not broken a single bottle in his experiments. M. de Vergnette-Lamotte, who made independent experiments, also recommends the application of heat. Of course some years must elapse before the effect of the process can be fully known. According to M. Lamotte, a temperature of 40° C., or 104° Fahr., rapidly causes wine to assume the properties conferred by age.

Phosphorescence at Sea.—On the 4th of September, at nine p.m., M. B. Coste noticed in lat. 9 N., long. 50 (French), what the French sailors call a "sea of milk" (*mer de lait*). It approached the ship in the form of a great sheet of white phosphorescent water, looking as if the sea were covered with snow as far as the horizon. The appearance was occasioned by myriads of minute gelatinous creatures, which he denominates *noctiluca miliaris*, though his description does not indicate that animal, which is nearly spherical, while those he saw were like "little straws covered with silver." Contrary to what is usual, and what he had noticed before, the furrows made in the water by the passage of the ship were dark and not luminous.

Monochromatic Light for the Microscope.—The Abbé Count Castracane states that by employing M. Foucault's heliostat and a prism of large dispersion, he illuminates the *Pleurosigma angulatum*, or other objects with any kind of monochromatic light. In the case of the *P. angulatum* he finds a bluish green exhibits the markings with a much lower power than when white light is employed. The account of the experiments, which we find given to us in the *Archives des Sciences*, is not intelligible to us as regards the powers employed. It says that with white light the fifth and strongest objective of an Amici microscope was necessary to resolve the markings of the diatom, while the third objective would do it with the monochromatic rays.

Application of the Spectroscope to the Microscope.—At the last meeting of the Microscopical Society, Mr. Browning read a paper on this subject, illustrated by numerous diagrams, showing the admirable arrangements he had devised. In one form of his apparatus a prism of peculiar shape possesses a small dispersive power in one direction, and a larger one in another, the rays having in both cases the same angle of emergence. By changing the position of this prism, it acts as a prism of smaller or greater angle, and is thus adapted to two classes of investigations, one needing less dispersion than the other. In Mr. Browning's method of mounting, the spectroscope can be used under the condenser or as an eyepiece. Probably the best eyepiece arrangement will be a direct vision prism of the sort made for Mr. Gassiot's electrical experiments. This gives a small dispersion adapted to show absorption bands in fluids, and when more dispersion is required, two prisms can be employed. Mr. Browning exhibited a spot of blood upon a card, about the size of a full stop in very small print, and stated that with one of his spectroscopes applied to the microscope Mr. Sorby had obtained a characteristic spectrum. In Mr. Browning's arrangements the spectra of opaque objects are easily seen, and blood globules or minute transparent cells observed more commodiously than is possible in the adaptation of the star spectroscope to the microscope, in the mode adopted in Mr. Huggins' important experiments. Mr. Glaisher, the President of the Microscopical Society, and Mr. Wenham spoke in the highest terms of Mr. Browning's arrangements.

New Living Object Trap.—Mr. Richard Beck described and exhibited at the last meeting of the Microscopical Society an ingenious contrivance for caging small creatures such as mites, with a view to their convenient examination. He drills a hole in a glass slide of the dimension required, and by a small piece of mechanism presses a strip of thin glass above and below the hole, so as to form a top and bottom to the little cell. The apparatus is reversible, so that the entrapped creature can be examined either way up. A series of these live traps fit into a small mahogany box, and will be found very convenient for processes of research, in which it is necessary that a small live object should be confined to a small space, but not injured. Water can easily be introduced into the little cells when required.

New Lieberkuhn.—Mr. Richard Beck likewise described and exhibited a new form of illuminator, consisting of a parabolic silver reflector, which slips on to the brass work of an objective, and presents somewhat the appearance of half a large lieberkuhn. It performs the function of the side silver reflector, and by special arrangements, which Mr. Beck described, it allows an object to be illuminated by nearly vertical rays. For some investigations Mr. Sorby found this illumination essential to success.

Production of Organisms in Closed Vessels.—No. 74 of the *Proceedings of the Royal Society* contains an account of a series of experiments apparently made with due precaution by Dr. G. W. Child on the production of organisms in vegetable infusions which had been boiled, which were closed after receiving a supply of air that had passed through red hot porcelain tubes. Notwithstanding these conditions, small bacterium bodies appeared, and Dr. Child states that organisms such as occurred in his vessels could not have been detected by the low powers employed by M. Pasteur. His conclusions are "either that the germs of bacteriums are capable of resisting the boiling temperature in a fluid, or they are spontaneously generated, or they are not organisms at all." He believes they are really minute vegetable forms, which is certainly the case in some specimens, though it is possible mere physical aggregations of minute globules may sometimes be taken for real bacteriums. He looks to Messrs. Powell and Lealand's $\frac{1}{50}$th as likely to elucidate the structure of these objects.

Passage of Dark Body across the Sun.—M. Le Verrier communicated to the French Academy a letter from M. Aristide Coumbary, stating he had observed at Constantinople on the 8th of May, about 9·23 a.m., a small dark body slowly passing across the solar disk.

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